SCIENTIFIC AMERICAN

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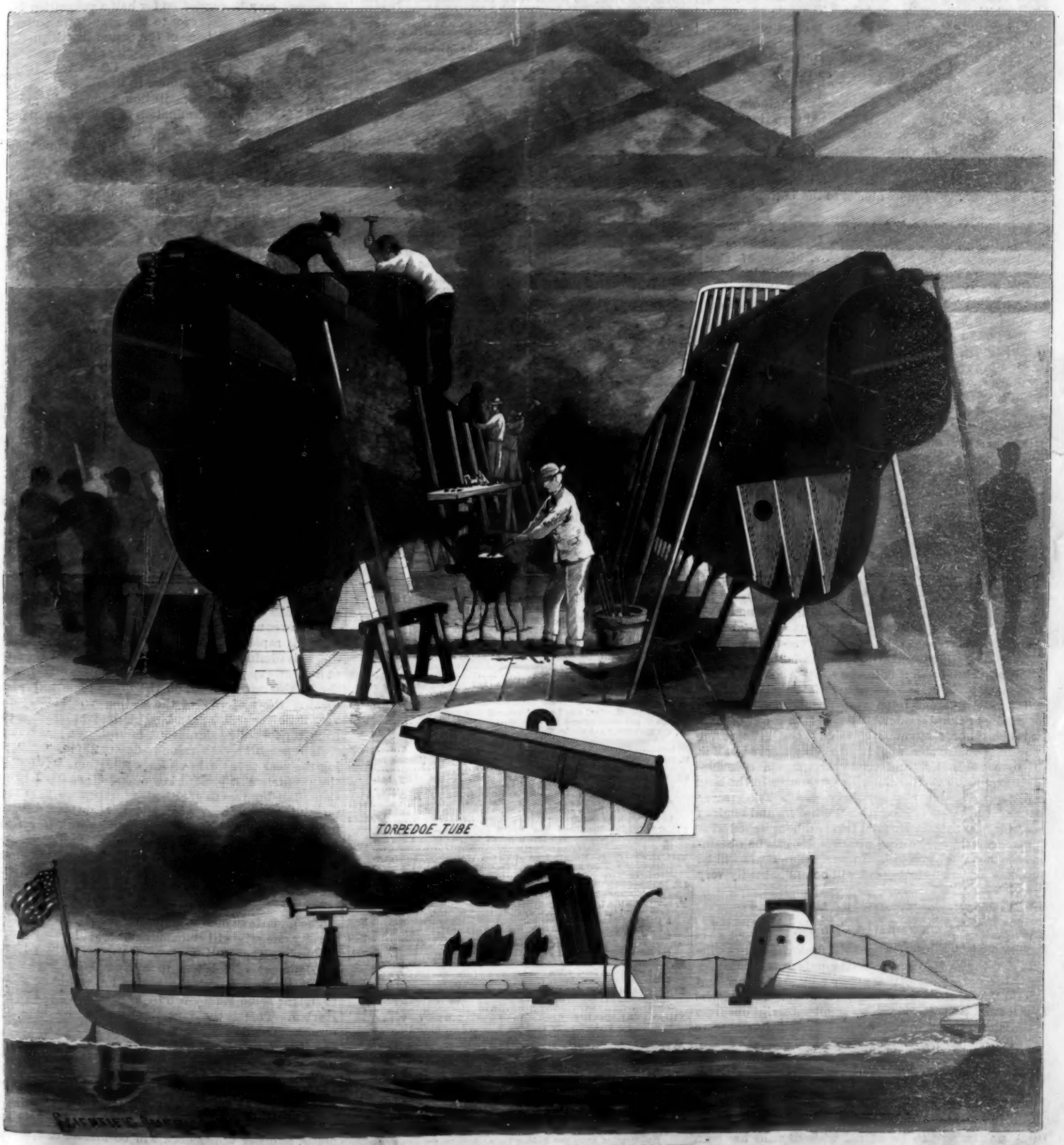
TORPEDO BOATS FOR THE CRUISER MAINE.

The United States battle ships Maine and Texas, named from States in the extreme north and south of the Union, represent a type of vessel which, although since improved upon, is a very powerful one. When completed, these two ships will embody almost all the modern developments in naval warfare. They are criticised as not being adequately provided with protection against modern rapid-firing guns and explosive shells, because when they were designed these weapons had not attained their present perfection. The Maine is being built at the New York Navy Yard, the Texas at the Norfolk Navy Yard.

Each ship is to be provided with two small torpedo boats, technically of the third class, and our illustration shows the operations in progress in the building of the Maine's boats. These little vessels are constructed with all the refinements of the shipbuilder's art. They are of steel throughout, with angle frames and butted plates with straps over the joints, all bolts and rivets being hammered flush with the surface of the skin. The plates, which below the water line are galvanized, are all hammered to shape, no plate being rolled to a curve. Much of this shaping is done cold, but where more elaborate work is desired the flanging is done hot. The plans for the boat, as furnished to the foreman, have the dimensions designated to a 64th of an inch, and up to the present period practically no error whatever in the dimensions has been found, a remarkable tribute to the workmanship of the New York Navy Yard.

The general dimensions of the boat are as follows: Length over all, 61 feet 8 inches; beam, 9 feet 1½ inches; draught, 2 feet 2 inches mean and 3 feet 4 inches maximum; displacement, 12·15 tons. Her coal and stores add about three tons to this displacement. Six watertight transverse bulkheads give seven watertight compartments.

The general disposition of parts includes an open



TORPEDO BOATS FOR THE CRUISER MAINE.

cockpit aft. Into this the rudder head enters, so that the boat can be steered from this cockpit if the conning tower has to be deserted. Forward of the cockpit comes the engine room, with a quadruple expansion engine, which of course will be of the last refinement of design. Forward of the engine comes the boiler room arranged for forced draft by the closed fire room system. The boilers are the Mosher tubulous boiler. Next to the boiler room comes another open cockpit, forward of which is the conning tower, which contains a steering wheel mounted on a half bulkhead. In the bows is placed the torpedo tube for discharging a Whitehead torpedo. In the extreme bow and also under the stern cockpit are trimming tanks. On deck aft is to be mounted a one-pounder rapid-firing gun, whose ammunition is carried in a magazine just aft of the engine room.

Along each side of the boat are coal bunkers, which, as far as their diminutive size permits, may be considered protective. Four heavy eyes are riveted to the sides along the waist by which the boat is to be hoisted bodily out of the water. The mast of the Maine carries a large steel boom, from whose end the tackle for hoisting the torpedo boats will be worked, the boats being taken in on deck by a steam winch. Cradles are to be provided for them to rest in.

The torpedoes will be carried by the Maine, the torpedo boat being able to carry only a single one at a time, which will rest in her tube. The role of action will simply be to get under way with the torpedo ready, then to approach the enemy as close as possible, to discharge the torpedo and run. Her side plates in places are but $\frac{1}{2}$ of an inch thick, so that she will be practically unprotected.

The crew includes the commander, engineer, firemen and two sailors. The Whitehead torpedo, which is used, weighs rather more than 2100 pounds, so that stability as well as a measure of protection to the machinery is secured by placing the weights as low as possible. Thus the engine cranks in their stroke work down between the frames almost to the bottom of the vessel.

The boiler consists of two upper and two lower horizontal cylinders, connected by 440 one inch drawn steel tubes. To prevent corrosion, blocks of zinc are contained in the cylinders connected with each other and by means of a copper wire with the steel of the boiler. On a forced draft the boiler will develop from 200 to 250 horse power with a pressure of 250 pounds. It is covered with a sectional non-conducting jacket; a valve damper in the ash pan cover allows air to enter, but in case of any outrush of flame caused by a steam leak or by the bursting of a tube, would instantly close. The boiler gives 513 square feet of heating surface and 14 square feet of grate surface. The engine is rated at 300 horse power when making 675 revolutions at the steam pressure cited. It has piston valves except for the low pressure cylinder. Great care is taken to balance the reciprocating parts so as to prevent vibration. The propeller shaft of forged steel is hollow; 8 inches external diameter with 2¼ inches bore. Thus the metal is only ⅝ inch thick.

The propeller is 8 feet in diameter and of 39 inches pitch, with an area on the screw faces of 4·1 square feet. There are two feed pumps for the boiler, and these can be connected so as to pump out the bilge. In conjunction with a steam ejector, which is connected to the bilge, a capacity of delivering 11 tons of water per hour is given, so that the little vessel may stand considerable injury and still be kept afloat.

As regards speed, it is hoped to get about 18 knots an hour at 300 horse power, and it is believed that this can be obtained upon the consumption of 1¾ lb. of coal per horse power. At this rate a ton of coal would last for six hours; so that if the little vessel was fully coaled she would have a high speed radius of over 100 miles, and at lower speed a considerably greater one. Her work throughout is in the best style and unexcelled by any steam yacht. The greater part of the vessel is filled with the boilers and engines and torpedo tubes. He trial trip will be watched with great interest as showing what results can be obtained with so small a vessel. In peace the boats will be used as dispatch boats, and will be undoubtedly very serviceable.

The First Anesthetic.

The fiftieth anniversary of the first use of anesthesia for the purpose of relieving pain was commemorated recently in a fitting manner by the Connecticut State Dental Society, at Hartford, Conn. A memorial tablet had been provided by small subscriptions from dentists in every State in the Union, as a tribute to the discoverer. Dr. Horace Wells; and this was placed upon the building which at present stands on the old site of Dr. Wells' office. The work was performed before a large and notable gathering of dentists and other scientists.

A HORSESHOE to be affixed without nails has been invented.

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DELAYED CASES IN THE PATENT OFFICE.

The United States Circuit Court, in the case of the Bell telephone patent of Berliner, filed 1877, and issued in 1891, fourteen years after the application was filed, held in effect that the applicant had purposely allowed the case to be delayed in the Patent Office until the original Bell patent had nearly expired; the object being to enable the Bell Company to have a continuance of its telephone monopoly for seventeen additional years. The court held the Berliner patent to be invalid for lack of diligence in prosecuting the application.

We notice that Edison has lately obtained several patents which have for years been pending in the Patent Office. One is for the manufacture of carbons, filed in 1880, fourteen years ago. Another for dynamo regulator, filed in 1881, thirteen years ago. Another for plating metals, filed in 1884, ten years ago. Another for carbon filaments, another for electric distribution, both filed in 1888, eight years ago. In 1892 Edison also received four patents for telephones, the applications for which were filed in 1877, fifteen years before the issue of the patents. These telephone patents, it is understood, are controlled by the Bell Telephone Company.

It is evident there is something wrong in the law which thus facilitates and apparently encourages these unconscionable delays. Preliminary litigations, it appears, may be carried on for half a generation before the Patent Office, prior to the grant of a patent. And, then, after the issue of the patent, battles in the courts are begun to settle the validity of the grant.

The remedy is plain. The duties of the Patent Office should be more strictly confined to the sphere specially provided for it by the constitution, namely, the grant of patents, not the determination of judicial questions. These latter should be relegated to the courts where they belong. Interference proceedings and questions of priority should have no place before the Patent Office. Its functions should be the issue of patents promptly to every applicant whose drawings and papers are properly prepared. A radical reform like this would put an end to the troubles, expense, and lingering delays to which inventors are now subjected, and would shut off all attempts at monopoly extension such as the Bell-Berliner trick.

The Seal Industry.

An official report has been published by the Treasury Department recently, confirming the stories of the outrages of pelagic sealing as permitted by the Paris regulations. It appears that the pelagic fleet of the past year has comprised some sixty vessels, which is four less than the fleet of last year. On the other hand, however, some 50,000 skins have been secured in 1894, mostly by Canadian hunters, against about 36,000 in 1893 and 25,000 in 1892. It will be seen that in two years, therefore, the Paris legislation has about doubled the very destruction it was designed to prevent.

It has also been found that pelagic sealing is in large measure directed against the mother seals, which, under our laws, were carefully protected. If this destruction continues, it is estimated that the value of the Pribylov Islands will be practically destroyed within the next five years. The estimated surviving population of the herd is 60,000 or 80,000 small males and 600,000 females.

The revenue of the Canadian government from this source is rapidly increasing, while that of the United States is diminishing. The United States is moreover at a great expense to provide a large patrol fleet, and the British government, on the other hand, although owning the majority of the sealing vessels, expends very little for police patrol. This may be clearly seen from the following significant figures. The surviving seals represent a cash value to-day of $7,000,000. During the year 1894 we have lost more than $500,000 of the profits. The present law makes it possible for the Canadian hunters to get about $1,000,000 worth of the remaining seals next year and to obtain an equally unjust share in the years to come, until the seal fisheries are exhausted. The United States, meanwhile, is compelled to pay a large sum annually out of the Treasury to guard and protect the seal fisheries.

Lobster Laws.

The game laws of Massachusetts provide a heavy fine for any one who either catches or sells lobsters measuring less than 10½ inches. Quite recently a large consignment of lobsters to a New York firm were seized in Boston, and the entire lot, consisting of 17 barrels or some 3,323 lobsters, were dumped in Boston Harbor. This is the largest seizure of its kind on record. The fine for each lobster is $5 and the shipper, if prosecuted, will be liable to a fine of over $16,000.

IT has been found that four hundred tons of top weight must be taken from the new French battle ship Breunus before she can be rendered seaworthy. It will be necessary to remove at least one of her fighting masts, and her upper deck will be almost completely dismantled.

DECISIONS RELATING TO PATENTS.

U. S. Circuit Court—District of Massachusetts.

UNITED STATES OF AMERICA v. AMERICAN BELL TELEPHONE COMPANY ET AL.

Decided December 18, 1894.

CARPENTER J.:

Patent to Emil Berliner, No. 463,569, dated November 17, 1891, is void because one of the functions of the device shown in the patent No 263,969, dated November 2, 1880, to the same inventor—namely, the function of transmitting articulate speech—is identical with the sole object or function of the device covered by the patent of 1891, and the device for effecting the transmission is identical in both patents. (Miller v. Eagle Manufacturing Co., 66 O. G., 845; 151 U. S., 186.)

The application was filed June 4, 1877; the patent granted Nov. 17, 1891. "The device covered by the patent in suit had been in public use by the respondent corporation since the year 1878. The respondent corporation was of ample means to prosecute the application. The result of any delay which may take place in the issue of the Berliner patent would evidently be to continue so much longer the practical monopoly of the art of electrical transmission of articulate speech." Under these circumstances the duty of the respondent corporation was to use the greatest degree of diligence in prosecuting the application to an early issue. "There should have been at least as great diligence as their own interests would have called for had their business been unprotected by patent rights." The delays subsequent to June 9, 1882, were unwarrantable, were acquiesced in, and therefore intended by the respondent corporation, and were such as to invalidate the patent.

Important Canal Improvements.

It has long been proposed to enlarge and generally improve the canal routes connecting New York with Philadelphia and Chesapeake Bay, and it now appears that this work is to be accomplished. These improvements are much needed and the expense incurred will doubtless be justified by the consequent increase of commerce. The city of Philadelphia some months ago appropriated $10,000 to be expended in making preliminary surveys and maps preparatory to enlarging the Delaware and Raritan Canal, and this has been followed by the appropriation of a like amount by the city of New York, for the same purpose. In addition to this a bill is now before Congress, having already passed the House of Representatives, providing for the appropriation of a sufficient sum of money to commence the actual work. Plans are also under discussion to enlarge and extend the Dismal Swamp Canal and the Albemarle and Chesapeake Canal.

The latest report of the surveyors of the Delaware and Raritan Canal stated that the full length of the proposed new route would be 32 miles. The surface elevation along this route is higher than in the case of the old canal, but it will probably be selected because it saves the building of two expensive overhead bridges. The new canal will then start from Raritan Bay, cross the Raritan River about eight miles below New Brunswick and enter the Delaware River at Bordentown. Eleven miles of its length will be an enlargement of the old canal. The other 21 miles will be an original excavation. It will have a depth of 24 feet, a bottom width of 90 feet and a surface width of 160 feet. It will be provided with two opening locks 500 by 60 feet, and four lift locks with a total lift of 50 feet. The entire cost has been estimated at $12,500,000. Of this amount $50,000 will be expended in deepening the channel of the Delaware River between Philadelphia and Bordentown.

It is, furthermore, proposed to make connections with the Dismal Swamp Canal, and to widen and deepen this canal in a similar way. The Dismal Swamp Canal commences at Deep Creek, Norfolk, Va., and extends in a southerly direction to South Mills, N. C., near the head waters of the Pasquotank River, which empties into Albemarle Sound. The canal proper is 22 miles long and 60 feet wide, and is provided with five locks. It has an average depth of 8 feet. It extends from deep water to deep water. An enlargement is being planned. It is proposed to give it an average depth of 10 feet and provide two locks, one at either end, to be 250 feet long and 40 feet wide. The estimated expense of these improvements will be $5,000,000.

The Albemarle and Chesapeake Canal connects the waters of the southern branch of the Elizabeth River, which has its mouth at Norfolk, with the North Landing River and North River. The canal is 14 miles long and has an average depth of 8 feet. The present owners propose to enlarge this to about the size of the others, so that large ships may pass through the entire system.

RUSSIAN engineers are studying a route for a waterway to connect the White Sea with the Baltic. The total distance to be covered is about 180 miles. Part of the route is already navigable. It is estimated that a uniform depth of thirty feet can be obtained along the entire route at a cost of $6,000 000.

Electric Tramways.

At the recent meeting of the American Society of Mechanical Engineers a paper was presented by Mr. C. J. Field, in which he reviews the first introduction of the trolley system seven years ago and its steady progress since that time. One of the difficulties met with in the introduction of the cable and electric road was the condition of the old horse road construction. The first step was the introduction of girder and T rails, which at first were 3 to 5 inches in depth, requiring the placing of the rails on a cast or wrought iron chair or stringer in order to get the depth over ties. This method proved little better than the old flat rail, especially at the joints. The rail mills then undertook the rolling of heavier and deeper girder and T rails, which, at present state of development, gives us, we believe, a roadbed construction equal to any steam road in the country. The standard to-day for electric tramway roadbed is 70 to 80 pound T rail, or 70 to 98 pound girder rail, the depth running from 7 to 9 inches.

The special work on track work, such as crossovers, turnouts, curves, etc., has also met with large improvement. Now we have as a standard for this special work the steel rails bent to the form required, and surrounded by a mass of cast metal to hold them together, and one company is turning out this special work with the parts welded together; also in cast steel. The electric welding of rails at the joints when laid is then mentioned. After one winter's test of a road built on this system, 6 per cent of the joints pulled apart.

Underground conduits, or the placing of the trolley wire with all its feeders under the surface of the street, is the ultimate and desirable result to be obtained in our large city lines of electric traction. Underground conduits were attempted four or five years ago, but on account of insufficient experience, lack of engineering ability, or amount of money expended on the work, as well as a desire on the part of the company installing them to make them a failure, they were not in general successful. The first really successful underground conduit to be installed and operated was in Buda-Pesth, about seven or eight miles in length, and it is now being extended to 30 miles or more. Similar systems on a smaller scale are in operation in Chicago and Washington. The conduit to be most used will be one similar to a cable conduit, with the trolley conductors placed at the sides in the shape of a channel or angle bar or rod of iron or copper, which will be divided into sections and fed by underground feeders laid along the line of the road. Shoes or brushes will convey the current from the trolley wire to the motors on the car. Such a conduit will only be successful where it is made a double trolley conduit and not depending on the track for the return circuit. The cost of a well built trolley conduit in the form of a cable duct will, in most cases, exceed that of a cable duct on straight track, but less on curves.

The general basis of calculation of the horse power required for a tramway system must take into consideration the local conditions of service, grades, curves, etc.; but, in general, 15 to 25 horse power per car in use on the road is the general limit of a well-designed station, which will include the conditions for continuous service and operation of the plant. A road of 100 cars would therefore require about 2,000 horse power, which horse power should be divided into say four units of 500 horse power each. The number of units in any station should be the fewest number which will give a safe and economical division of the units, and in a station of this kind four or five units, according to the service and conditions, should be the standard.

The old horse car road in large cities operated at a total cost of from 18 to 25 cents per car mile. One car mile is taken as the standard for operating expenses in our tramway service. The heaviest item in this operating expense was the question of power, and this is where the electric road has made its heaviest gains in the reduction of operating expenses. This item is reduced in power in service to-day to a cost, under general conditions, ranging from 1 to 1½ cents per car mile. The relative proportion of operating expenses to earnings in the horse service was from 70 to 80 per cent operating expenses to gross earnings. In electric service we have a considerable increase in our gross earnings over our old horse line, which increase runs from 25 to 50 and even 100 per cent in some cases, and the operating expenses being 40 to 60 per cent of the gross earnings. In this operating expense we include all the operating expenses of the road other than the fixed charges.

The cost of building and equipping an electric road is considerable. The standard price four years ago for an equipment of two 15 horse power motors and the installation of them was $3,000 to $3,500. The price to-day for two 25 horse power motors, which are much superior to the former ones, is under $1,000. This gives us a total cost of a motor car, including car body, truck, motors, etc., of approximately $2,200. A single mile of roadbed construction, with 90 pound girder rail, exclusive of any new pavement, but including taking up of the old track and replacing of old pavement, about $7,500 per mile of single track. This makes no allowance for special work. Overhead-line construction for one mile of double track, with iron poles, feeders, etc., $4,000 to $5,000 per mile; with wooden poles, about $3,000 or $4,000 per mile. Steam and electric plant for direct-connected vertical compound condensing plant—for steam plant, $50 to $55 per horse power, and the electrical, $20 to $25 per horse power, making a total for steam and electric plant, $70 to $80 per horse power. As a general summary, we have for the total cost of the equipment of the electric tram road—that is, the rebuilding of an old horse road—including power plant complete, buildings, car house, cars, equipment, track, and overhead construction, $20,000 to $25,000 per mile of single track, according to the varying conditions of different cases.

War on the Gypsy Moth.

Extensive preparations are being made in New England for destroying the Gypsy moth or Oeneria dispar, which has become of late a very serious menace to agriculture. An appropriation of $200,000 has been asked of Congress to be expended for this purpose, and it is expected that it will be granted. About 150 men will be employed in the work and the whole of the infested region will be kept, as far as possible, under constant inspection.

The Gypsy moth is indigenous in France and was brought to America in 1870. Since then it has multiplied with alarming rapidity. The moth deposits its eggs in clusters in sheltered places on the bark of trees or in cavities of stone walls, old stumps and similar places, but always near the plants or trees on which the insect feeds. Eggs are deposited in the early fall and hatch early in the spring. When first hatched the caterpillars are less than one-fifth of an inch long, and when fully grown they shed their outer covering and become pupæ. They feed only when in the caterpillar state, which lasts about ten weeks. They are nocturnal and feed in bands and attack all kinds of shrubbery.

In 1892, when the first attacks upon this pest were commenced, the clusters were destroyed by scraping them from the trees and burning them. This plan was given up, however, because some of the eggs were often scattered and lost. At present various acids and creosotes are used, and when the eggs are deposited in cavities they are destroyed by chlorine gas or fire. Another plan is to brand the trees with burlaps and lime. Some idea of the extent of this work may be gained from the report made by the State Board of Agriculture recently. It appears from this that $101,411 were expended during the year 1894. Over 200 square miles of farm lands were infected, including some of the most valuable land in New England, and 125 men were employed in carrying on the work.

The Pneumatic Tire.

An interesting series of experiments have been made recently to test the difference between the draught or road friction of a carriage with and without the modern pneumatic tired wheels. Two ordinary box buggies were employed, each being weighted to weigh 254 pounds. On a smooth hard pine floor it was found that the power required to start the pneumatic tire from a standstill was four pounds and the power required to start the steel tired carriage was three pounds. Next an obstruction $\frac{1}{8}$ of an inch high was placed in front of each carriage, and it was found that 25 pounds was required to haul the steel tired carriage over the obstruction and but 11 pounds to draw the pneumatic tired carriage.

Similar experiments with obstructions of various kinds showed that about the same advantage was maintained by the pneumatic tires. To haul the two carriages over an ordinary sand road it was found that the steel tires required about 40 pounds and the pneumatic about 25 pounds. A great many experiments of the same nature showed little or no variation in this proportion.

Gold Fillings.

People, says a dentist, wonder why gold is used for stopping, and are apt to credit the dentist with employing it for his own ends, on the ground that he can charge more and get correspondingly larger profits than would be the case if he used any baser and less expensive metal; but, he says, in explanation, a little reflection would convince the suspicious ones that there is no ground whatever for such ideas, and that the real reason for using gold is that it will weld while cold, and will successfully resist the action of the acids and fluids of the mouth, hence it is unequaled as a preservative for the teeth.

IN a recent issue we explained the proposed system of establishing an international postage stamp. It is already reported that Cape Colony will join this "Universal Postal Union" on January 1, 1895. It has been decided that a five cent stamp will carry a letter to any civilized country of any importance in the world. We take pleasure in announcing that at present the only countries not included in the union are China, Morocco, the Orange Free States, and the islands of Ascension, St. Helena and Pitcairn.

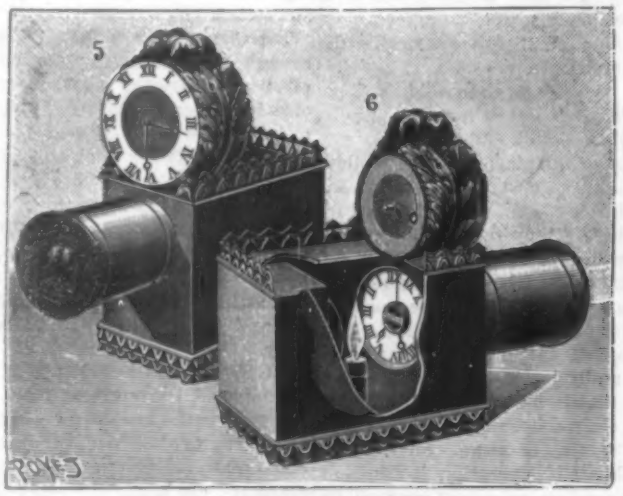
THE CURIOSITIES OF CLOCKWORK.

As soon as horary instruments had been constructed an endeavor was made to utilize them at night just as in the daytime. Gnomons or sun dials could not be employed for this purpose, especially in the interior of houses. Although the time was obtained by means of a plumb line held vertically opposite the pole star, this was possible only in clear weather and in the country.

Clepsydras, or water clocks, were then alone capable of solving this problem, and so the idea occurred to illuminate them at night. It is, therefore, of clocks luminous in darkness that we are going to speak—of those of which the tradition has been perpetuated to our day, despite the most practical methods of clockwork. We shall occupy ourselves here only with the house clock or the ornamental clock, for the luminous dial of the public clocks is still of extreme utility at the present time.

In studying the history of clepsydras, we find that certain of these pieces, already very complicated, were provided with a style of lamp that permitted of seeing the hour despite the darkness. Such was the clepsydra constructed in China, and mention of which is made in the Tchan-li, a book that dates back to the year 202 before our era. The same is the case with the Arabian clepsydra that was in the mosque at Damascus in 1184. There were many others of this kind. The idea of the night light, differently applied, is found again in clocks with spring movement from the epoch of the Renaissance down to our day.

We are going to speak of some curious types in order to give an idea of the multiple means employed by clockmakers for giving the time at night.



Figs. 5 and 6.—LANTERN CLOCK.
Fig. 5.—External view. Fig. 6.—Details of the internal mechanism.

The sixteenth century was peculiarly prolific in matters of clockwork, both as regards inventions and decoration, and we are able fearlessly to assert that nothing new has been done since, in the way of ingenious conceptions. The following, for example, is a description of an alarm clock invented by Caravagius for Andre Alciat.

"At the moment at which the bell struck the hours, a spark drawn from a flint by means of a pistol battery placed at the desired spot fell upon a sulphur (sic), which was ignited and lighted the wick of a candle." This kind of time piece was not unique, and we still find old specimens of it in our day. They are of finely chased gilded copper.

In Fig. 1 we reproduce a Renaissance clock of the same epoch in the form of a pyx. Beneath the dial, which is mounted upon a man's head forming a pedestal, there is a burner of a lamp in which is placed a wick that enters the oil contained in the body of the man and the foot upon which it rests. It was this lamp that illuminated the dial at night. This piece is of gilded bronze. The pedestal is finely chased and the entire surface is covered with engraving.

We have in our possession a curious clock made at Saltzburg at the beginning of the seventeenth century (Fig. 2). It consists of a plate ornamented with motifs in repousse copper and accompanied with two dials, one above the other. About the lower dial, which serves to show the time during the day, there is nothing peculiar. It is a copper disk upon which are engraved the hours, which are indicated by a very elegant steel hand. The upper dial is entirely different, and its composition has pretensions to the mysterious. The hours are printed in black upon a glass disk which is fixed in the plate forming the front of the case. It is, therefore, immovable. Behind this disk, and applied almost immediately against it, there is another glass plate upon which is painted a small figure in black holding in its hand a wand that serves to mark the hours.

This second glass plate is circular and at its circumference, behind an ornament, there is concealed a toothed wheel that is sealed to it. This wheel engages with a dial train that corresponds to that of the lower dial, so that the movement, in running, actuates the day and night dials at the same time. The night dial is illuminated by a lamp placed behind it. As the two glass plates are transparent, it is necessary to make some examination in order to understand the system, for the two plates of glass seem to make but one, and to form one and the same dial only.

In our collection we have also a night lamp that serves to show the time (Fig. 3), and that constitutes a genuine clepsydra. These kinds of clocks were relatively common in the seventeenth century. They were especially clocks for studies. They consisted of a lamp placed at the base of a glass receptacle mounted vertically by a screw upon a tin foot, to which it was fixed by two strips of the same metal. Upon one of these latter (the one facing the burner of the lamp) was read the hours of the night cast in relief. They began at 4 o'clock in the afternoon, the hour at which the lamp was to be lighted in winter, and ended at 7 o'clock in the morning. The glass receptacle was removed by unscrewing it from its foot when it became necessary to refill it with oil. After being put back in place, and the lamp having been lighted, it was the level of the oil that marked the hour in descending in measure as the combustion proceeded.

Much later on, in 1819, a clockmaker named Gabry, of Liancourt, utilized the same principle for constructing a system of night lamp of which we possess a specimen (Fig. 8). It is a reminiscence of the antique Indian (or Hindoo?) clepsydra. It consists of two juxtaposed porcelain cylinders that communicate by a conduit formed at the base of the partition that separates them. Above this partition there rises a plate of iron with a dial painted upon one of its faces. The two vessels are filled with oil, and in the one in front of the dial is placed a night lamp to illuminate it. In the other there is suspended a float through a cord that passes around a pulley mounted upon a horizontal axis ending in the center of the dial. This float descending in measure as the combustion of the oil proceeds, carries along with it the hand fixed upon the axis in front of the dial and thus marks the hours.

The precision of these clocks must certainly have been most mediocre, whatever may have been the care taken to direct the flame of the wick. A Dutch night lamp of the eighteenth century indicates to us a new combination (Fig. 4). The hours are formed in open work upon the metallic disk forming the dial, which revolves and presents all the hours in succession beneath a dove, which is likewise in openwork and serves as a pointer. A light placed upon the case inclosing the movement thus renders both the hour and the dove luminous in the midst of darkness. This piece, which is of genuine interest, is entirely of polished copper. The dial alone is silvered.

In Schubler's Architecture we find engravings of two clocks dated 1734. One of them has a luminous dial that projects the hour directly upon the floor with a considerable enlargement that is effected by the dial itself, which is composed of a lens. The other is a true magic lantern with an objective that projects the hour upon the wall. These two clocks, of large size, are very richly ornamented, and are of a beautiful decorative aspect, although in a somewhat questionable taste.

Fi s. 7 and 8. ILLUMINATED CLOCKS.

The idea of this magic lantern clock has been taken up in other proportions and under various forms. We own a mantel clock dating back to the first empire (Figs. 5 and 6), and consisting of a copper case, having upon its face a magic lantern objective, behind which there is a glass dial upon which the hours are painted.

This transparent dial is actuated by an almost invisible train which is run by the movement of the clock placed upon the upper part of the case. The dial of this movement is above the objective and thus gives the hour during the day. Behind the dial that is in the case there is a lamp which is lighted at night so as to obtain a luminous projection of the dial of a very large diameter, either upon a wall or upon a screen.

In 1828, a Mr. Rehart took out a patent for a magic lantern serving to amplify the dial of a watch. Under the empire, many night clocks were brought out. The most common were composed of a metallic ring into which was set a ground glass dial carrying the hours painted in black (Fig. 7). In the center of this dial there was a chased copper rose behind which was concealed a watch movement. A night lamp placed behind illuminated the hands, and the hours stood out in black upon the white disk.

This dial was mounted upon a foot of chased bronze of which the decorative motif varied to infinity. Nevertheless, as in the specimen that we reproduce, it was frequently in the form of a human figure.

These different clocks are, as may be seen, somewhat crude, and certain of them are far from offering very serious guarantees of running.

In our day night clocks of various styles have been constructed. But all this responds but imperfectly to the object proposed, and it may be concluded that the time of night will be known very much better from the bells of clocks than from the light that illuminates them.

It is especially starting from the seventeenth century (1676) that with timepieces giving the hour at will the problem has been solved. We have thus, according to requirements, the hour, the half, the quarter, and sometimes even the minute. At present the tra-

Figs. 1 to 4.—ANCIENT CLOCKS.
Fig 1.—Dutch clock. Fig. 2.—Mysterious clock. Fig. 3.—Lamp clock. Fig. 4.—Dutch illuminated clock.

veling clock, with its large bell, has had the last word to say of the hour of night, and is advantageously replacing all the clocks and night light arrangements that have been invented since centuries.—M. Planchon, in La Nature.

NEW CHEMIST'S WASH BOTTLE.

The wash bottle shown in the cuts represents one of a kind which I have used for three years, and it has proved so convenient, not only for hot water wash bottles, but also other wash bottles, that I think it will prove of interest to your chemical readers.

One cut represents the bottle complete; the other shows it in use, and also shows a large scale view of the valve. Its construction is obvious. The wire crosses a piece of rubber tubing. When the wire is depressed it squeezes the tubing against the wooden block on which it is mounted and thus closes it valve-fashion.

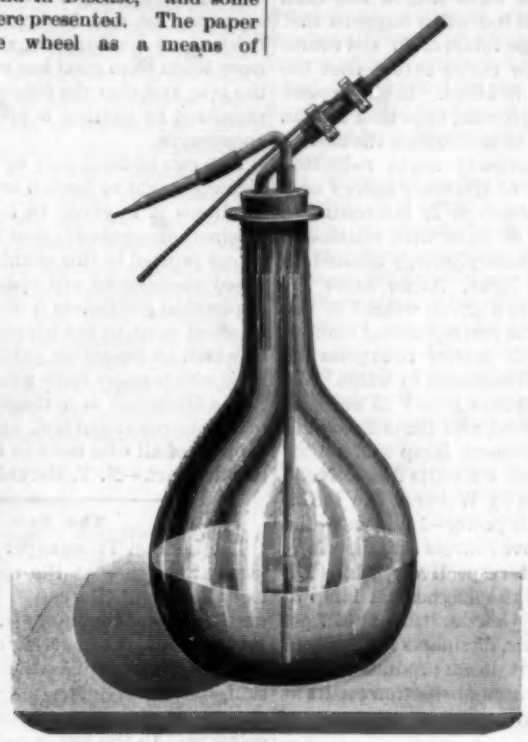
The middle finger controls the wire of the valve, allowing the free use of the first finger to direct the stream—a great improvement on other similar apparatus.

When the bottle is reversed, the middle finger also controls the stream issuing from the mouth tube—a very convenient feature.

After a short use of the bottle, one soon becomes accustomed to the mechanism, so that the mouth and hand work together. The air chamber ordinarily above the water is sufficient to eject the water for five or ten minutes, and with the hot water bottle it is only necessary to shake the water, and the steam liberated is ample to force the water from the top. Another great advantage is that one runs no risk of burning the mouth, as the valve prevents the steam returning until the mouth is removed.

GEO. C. JAMES, Chemist.

WASH BOTTLE IN USE, WITH VIEW OF VALVE.



NEW WASH BOTTLE.

Inventions Reduce the Cost of Building.

The Real Estate Record commented some time ago upon the immense reduction that has been made within the last decade in the cost of building. Office buildings that cost $1.50 per cubic foot, and even more, can be produced by modern methods for 30 or 40 cents a cubic foot. This reduction in cost is due in no slight measure to the employment of mechanical devices in building operations. The hod carrier, elevator, derrick, and other devices worked by steam, which have superseded the slow hand labor, are too well known to be mentioned. The employment of steam power in the mechanical operation of building has, however, by no means reached its limit. At the New York building, now erecting on the block front between Waverly Place and Washington Place, passers-by may see a steam stone crusher at work preparing material for the foundation. A few hands are able to do with precision an amount of work which formerly required a small regiment of men. On the line of the new Lexington Avenue cable road a cement stone mixer worked by steam is in operation, and attracts the attention of passers-by.

For Obesity.

Take no water or other fluid at any time, says the Medical Times and Register, except one cup of any desired hot drink, just before rising from the table. Use no liquids while eating. Avoid sugar, nuts, and pastry. Eat nothing between meals. Confine the diet to lean beef, mutton, chicken, turkey, fish, eggs, oysters, with one slice of stale bread well dipped, the bulk of the meal being of tomatoes, celery, spinach, turnips, cabbage leaf, but not the fleshy mid-rib, and fresh or dried fruits, cooked without sugar, such as apples, peaches, plums, prunes, prunellas.

A little cheese is permissible; coffee, tea, skimmed milk or buttermilk after eating as stated. Exercise should be taken, running being most effectual, before breakfast or before going to bed.

Healthfulness of Bicycling.

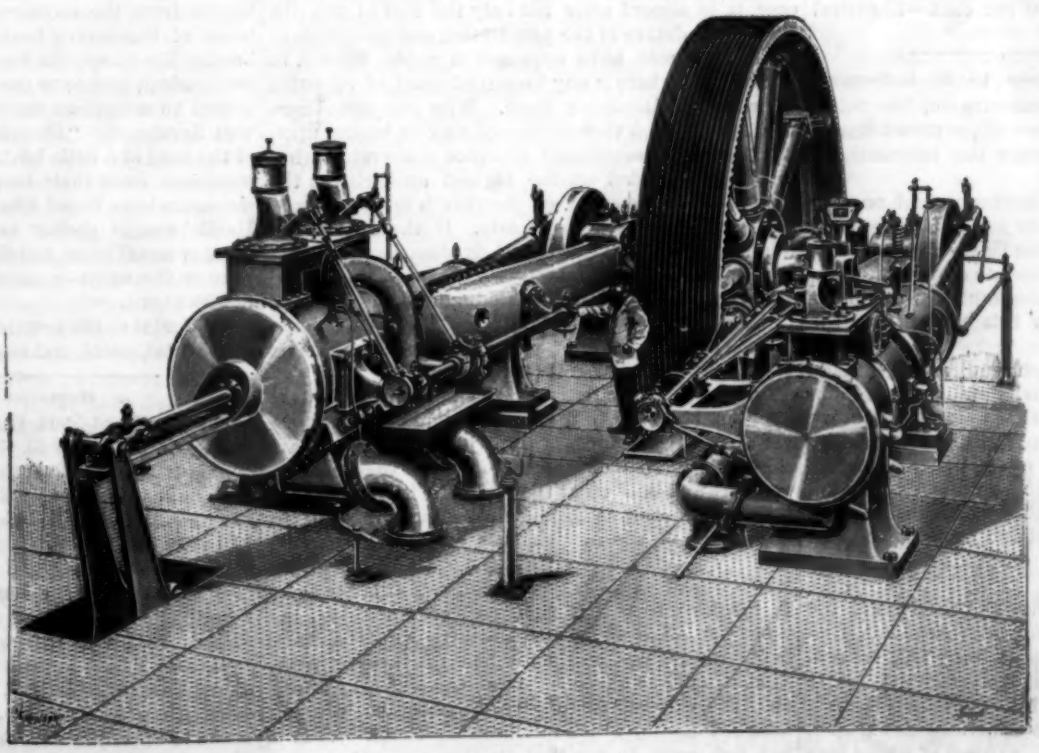
An interesting paper was read recently before the New York Academy of Medicine, on "The Influence of the Bicycle in Health and in Disease," and some very important statistics were presented. The paper warmly recommended the wheel as a means of healthful exercise. The conclusions were based upon examinations of a number of men who had used the wheel constantly for periods varying from five to fifteen years. During this time each of these riders had ridden more than 5,000 miles and less than 30,000 miles. It was found that the average chest expansion of these riders was 1 4-7 inches. The chest of the average man expands only one inch. In the strength and general condition of the heart the bicyclists had a similar advantage, and a considerably increased lung power was also observed. There was also noticeable an harmonious development of all the muscles, and in no case was any deformation of the spinal column or other part to be found. The criticism that the continued use of the wheel merely develops the muscles of the legs at the expense of other parts was not found to be true in any of these cases. The writer of the paper, however, condemned long distance racing as injurious, and offered a general caution against excessive and exhaustive feats of bicycle riding.

NINE HUNDRED HORSE POWER COMPOUND ENGINE.

The engine here illustrated is a fine specimen of modern engineering, and has been manufactured by the well-known engine makers, Messrs. Robey & Co., Limited, of the Globe Works, Lincoln. The cylinders are placed side by side, with the fly wheel in the center. The diameter of the high pressure cylinder is 24 in., low pressure 40 in., and stroke 48 in.; and with a steam pressure of 100 lb. per square inch the engine will, when condensing, give off 900 indicated horse power. A condenser, of the injection type, worked by an extension of the low pressure piston rod through a rocking lever, is placed at the rear of the low pressure cylinder, and at a lower level; the air pumps are single acting, two in number, each 28 ⅝ in. diameter. The main shaft is exceedingly massive, being 15½ in. diameter in the center, the main bearings being 12 in. diameter by 24 in. long, thus giving ample bearing surface.

The power is transmitted by means of a fly wheel, 18 ft. diameter, grooved for fourteen ropes, 1¾ in. diameter, and the rim is built up of ten segments, the latter being carried by ten arms, which are fastened in the central boss by double cotters. The main feature, however, in this engine is the trip valve gear, which is Richardson and Rowland's patent, and works with a smoothness and precision which leaves nothing to be desired. The inlet valves on the high pressure cylinder are of the double beat type, and are actuated by trip levers, which again receive their motion from a cross shaft driven from the main shaft of the engine by cut gearing. The trippers which lift the valve are coupled to the governor, which by means of a simple motion adjusts the cut-off from zero to ¾, by sliding the tripper into longer or shorter communication with the tripping lever. This arrangement has been found in numerous examples to be most effective, and controls the speed of the engine within less than one per cent on ordinary variations in load. The exhaust valves are underneath the cylinders and have large openings with a very small movement, thus giving a free exhaust, and draining the cylinders effectually. A large receiver is situated between the two cylinders, into which the high pressure exhausts; here it is reheated by means of a live steam coil, and enters the low pressure cylinder at a slightly enhanced pressure.

The economy of steam consumption in this type of engine has been proved to be very considerable, and with the engine illustrated the consumption has been brought to the lowest practicable point. As a proof of the accurate balancing of all parts, the engine was erected on a temporary foundation of timber and moulding boxes, at a height of 10 ft. from the ground level, and on this slight foundation run at the full speed of 75 revolutions per minute, with scarcely any perceptible vibration. The engine is for driving a large mill in Russia, and has been specially designed to render transport easier, the girder bed being made in two halves, and bolted securely together, and a foot placed in the center, whereby absolute rigidity is obtained. The fly wheel has been turned dead true, a result seldom obtained with equal accuracy with so large a wheel. We are indebted to the Engineer, London, for our cut and the above particulars.



NINE HUNDRED HORSE POWER COMPOUND ENGINE.

MORTUARY tables show that the average duration of the life of women, in European countries, is something less than that of men. Notwithstanding this fact, of the list of centenarians collected by the British Association a fraction over two-thirds were women.

The Light of the Future.

Dr. Palaz, in his work on photometry, remarks that to improve the optical efficiency of light sources "there should only be produced such vibrations of the ether as are susceptible of affecting the retina," or vibrations having a wave length between 0·81μ and 0·36μ —μ being 0·001 mm. The problem thus is not a complicated one as far as its statement is concerned, and when we learn that the greater part of the energy of the voltaic arc is lost in heat at a wave length of only 1·16μ, we see that the question of producing "cold light" resolves itself into one of reducing this wave length less than 50 per cent. Unfortunately it too often happens that what to nature is but a minute interval in the course of a phenomenon is yet the entire extent that the powers of man are permitted to affect. In the present instance there is, however, a growing hope that human endeavor will finally succeed in so directing the motion of the ether that the numerically slight reduction necessary in the wave length of vibratory energy may be obtained. In this connection it is interesting to compare the various sources of light with relation to the proportion of their vibratory energy utilized in producing the sensation of light. As we know the amount of energy contained in a given weight or volume of oil and gas and also the corresponding amount of light produced, it is a simple matter to express the unit of light given by these illuminants in watts. We thus find that an oil flame requires about 42 watts of energy per candle power emitted, and the ordinary gas jet 93 watts; with the incandescent lamp and voltaic arc these figures are 3·1 and 0·8 watts respectively. Accepting the efficiency given by Weber of the incandescent lamp at normal candle power—1 per cent—the optical efficiencies of the above sources are, therefore, 0·07, 0·03, 1·0 and 4 per cent respectively, while Dr. Palaz quotes the efficiency of the magnesium lamp at 15 per cent and that of the Geissler tube at 32·7 per cent. The gas flame, therefore, dissipates 99·3 per cent of its energy in vibrations that do not produce the sensation of light, and the maximum dissipation occurs at a wave length of 1·6μ, the corresponding maximum of the voltaic arc being 1·16μ.

We see from the above that high optical efficiencies are obtained in three ways—by a high degree of incandescence of carbon and of magnesium and by vibratory motion set up in the ether by an electric discharge through a Geissler tube. With carbon as a material we cannot expect a greater efficiency of the arc lamp than at present, as it has been shown that the temperature of the crater cannot be increased (unless under pressure), since it now corresponds to the point of vaporization, while the incandescence of the carbon filament has also probably reached a practical limit. The only chance of improvement in this direction, then, seems to lie in the utilization of a material which may be raised to a higher temperature and incandescence than carbon, or, like magnesium, will at a given temperature give off a much larger number of luminous rays than carbon. The experiments of Tesla and Ebert in producing the requisite rate of etheric vibration by electrical instead of thermal means contain the greatest promise, even if the efficiency of the Geissler tube is merely attained in a practical light, and there is hope that it may extend much further than this. Finally, it is not impossible that we may even solve the mystery of the light of the firefly, which would be the most perfect solution of the problem. Langley finds that all of the radiations emitted from this source have a wave length between 0·45μ and 0·65μ, and therefore the optical efficiency is probably 100 per cent.—Electrical World.

International Copyright Abuses to be Reformed.

Representative Hicks, of Pennsylvania, has introduced in the House a bill aimed at the most flagrant abuse that has grown up under the international copyright law.

That law gives to foreign authors copyright on condition that their productions be published here from type set or plates made in the United States. The same condition is imposed in the case of musical compositions, photographs, and lithographs. The plates or negatives must be made in this country and the copies printed from them here.

But, curiously enough, no such requirement is made in the case of engravings or etchings. Foreign publishing houses have not been slow to take advantage of this omission by claiming copyright for engravings, etchings, drawings, woodcuts, etc., when neither the plates have been made nor even the copies printed in this country. Not only have they claimed such copyright, but they have threatened and brought suits for its alleged infringement and demanded damages in ridiculously high sums.

It must be obvious to every fair and intelligent mind that there is no good reason for this marked discrimination of foreign art as against literary and musical copyright. That the discrimination opens the door to intolerable abuses is shown by experience. It is a standing menace to reputable American newspaper, magazine, and book publishers, any one of whom may at any time become the victim of unwarranted and vexatious litigation for having innocently reproduced from some foreign publication an illustration not supposed to be entitled to copyright. Such suits may even in unscrupulous hands become the weapons of attempted blackmail by carrying a demand for excessive damages only for the purpose of securing a smaller sum by way of compromise.

A law which thus invites abusive litigation, which is taken advantage of by foreign speculators and their American attorneys to harass American publishers, is neither to the interest nor the credit of the United States, and hence should be amended at once. Whatever may be said in favor of granting protection to foreign art productions, experience has proved that more harm than good has come from the operation of the law, and that the interests of this country will be promoted by putting a prompt veto on the abuses it encourages.

This can be done only by amending the law so as to give copyright to foreign art productions on the same condition it is given to foreign literary and musical productions—namely, that the plates be made and the copies printed in this country. To say that the proposed amendment will operate only to the advantage of piratical publishers is nonsense. Its purpose is and its effect must be the suppression of abusive litigation, to which all reputable publishers are now exposed, and from which many have already suffered.

The Hicks bill is a timely measure, designed to improve the copyright law, and hence should receive the support of all who have in this matter American interests at heart.—N. Y. Herald.

The New Element.

The London Times says: "There was an unusually large attendance at the meeting of the Chemical Society last night (December 13), in anticipation of a discussion upon the new element announced by Lord Rayleigh at the meeting of the British Association. None of the scientific societies were at that time in session, but our readers may remember that a certain amount of discussion on the subject took place in our columns. In the five months that have elapsed since the announcement was made, chemists naturally supposed that definite and unassailable conclusions would have been reached. This expectation was naturally very powerfully confirmed by the language of the president of the Royal Society, who in his presidential address treated the discovery as fully authenticated, and described it as the greatest scientific event of the year. It was, therefore, a serious disappointment to the Chemical Society to discover last night that not one of the men known to have been engaged in working at the new element came forward to give information as to results so unequivocally proclaimed. Some astonishment was also felt when the president of the society observed that a good deal of feeling had been called forth by this question, notwithstanding its purely scientific character.

"It was evident from his remarks that the discoverers of the new element are anxious to forbid discussion, on the extraordinary ground that, as they have not published their conclusions, discussion can proceed only upon private and confidential information. It is obvious, as he pointed out, that when chemists are informed that they have entirely failed to comprehend the constitution of a substance upon which they have bestowed so much labor as has been expended on the atmosphere, they have an indefeasible right to carry out whatever experiments they may think fit. Moreover, it is absurd after not only the fact of the discovery but details of the preparation and properties of the new element have appeared in public reports, to pretend that there is any breach of social or scientific etiquette in discussing them. Why the discoverers should impose on themselves and seek to impose upon others this extraordinary reticence concerning what has been heralded on the highest authority as the greatest scientific event of the year is more than any one seems prepared to explain. If there were any question of robbing them of their discovery, it would be another matter; but, on the contrary, the acceptance and discussion of the announcements made to the British Association and to the Royal Society are the very best means of securing to them whatever credit may accrue from their researches.

"Professor Dewar described last night the methods of applying liquid air to the investigation of the properties of gases. It appears from his experiments that chemically prepared nitrogen liquefies at the same temperature and boils off at the same rate as nitrogen obtained from the atmosphere. Yet, according to the discoverers of the new element, one contains a substance which is not present in the other, the density of which is nearly half as great again as that of nitrogen. It follows either that the new substance does not liquefy at all, even at temperatures which condense much rarer gases, or that it behaves in exactly the same manner as nitrogen. Chemists will fully appreciate the extreme singularity of a substance with the assigned density which fulfills either condition. It is not too much to say that its discovery would revolutionize chemical theory. But the whole question becomes infinitely more obscure if, as seems to be the case, chemically prepared nitrogen passed over red-hot magnesium behaves in a manner undistinguishable from that of atmospheric nitrogen treated in the same manner. Confirmation of this result would at once prove that the new substance is a manufactured product which may, indeed, be present in the atmosphere, but cannot be a new element. With these grave uncertainties brooding over their discovery, it is remarkable that Lord Rayleigh and Professor Ramsay should prefer to keep silence, although all doubts might have been settled almost in as many days as months have elapsed since the announcement to the British Association."

Science Notes.

From the Boston Commonwealth we take the following:

Before a recent meeting of the Parker Memorial Science Class, Prof. A. E. Dolbear considered the possibilities of matter, which in the light of the most recent investigations is of exceeding interest. He said that the kind of phenomena which one expects from matter depends largely upon what are assumed to be the properties of matter. It was once thought that matter itself was altogether inert and lifeless, and forces of different kinds were believed to be necessary in order to have it do anything. Now we are aware that this notion is erroneous. A lump of coal weighing a pound possesses energy enough to lift its weight nearly two thousand miles high. Every particle of matter is constantly exerting its influence upon every other particle of matter, no matter how far apart they may be, and if left to themselves, will come together.

The power to do this is inherent in matter and not in forces external to it, so that one after another the so-called forces have been given up, as representing anything more than some sort of motion. There is left, then, only matter and ether and various forms of motion to account for the different phenomena in nature. Even what are called organic phenomena, such as belong to living things, have no other antecedents.

These new considerations have made it necessary to recast our opinion concerning matter and its possibilities. Instead of the hard, round, inert particles of the older philosophers, we have now the vortex ring theory of atoms, which considers them as rotating rings of ether, since such rings exhibit many of the qualities possessed by matter. But this view makes atoms dynamic individuals possessing energy and capable of doing many things. The phenomena of crystals and some of the lower orders of animal life show such similarity as to give one the impression that the former are in some degree living things, and there is a growing conviction, among those who study molecular phenomena, that matter is really itself alive and that intelligence is in some way associated with it, so as to make the difference between the atom and man only one of degree.

A very interesting lecture was that recently given by Miss Charlotte W. Hawes, the subject of which was "Music in Nature." Miss Hawes has a way of her own in approaching her subjects, and her enthusiasm, her impressive manner, as well as the range of the information which she imparts, give her lectures great interest even aside from their musical character. In the present instance she showed how nature is everywhere musical; that the most common and simple actions produced musical and harmonious sounds, from the patter of berries from the measure into the pan to the grand tones of the waves beating upon the beach. The brooks, the winds, the trees, the raindrops, all of these are musical; and as to the birds, they have often suggested to musicians the themes which have been so well developed. "Pleyel's Hymn" is but the setting of the song of a little bird. From such things the rude musicians drew their inspirations, and in these our musicians have found a basis. In the midst of a shower, Handel sought shelter in a blacksmith shop, and the clink of metal upon metal—the hammer striking the iron or the anvil—suggested to him a new spirit to a familiar tune.

Incidental to the lecture were many illustrations, instrumental, vocal, and imitative.

Remarkable Mirage.

The people of Port Huron witnessed a remarkable mirage on December 25, showing the Canadian bank of the St. Clair River for about thirteen miles, and both banks from Marysville to what is known as McGregor's Point, a mile below the Oakland House. At 7:30 o'clock in the morning, on looking to the south, Port Huron people could see Sarnia reflected in the clouds, and even the ferryboats as they crossed the river. The frame houses stood out boldly, making an exceedingly pretty panorama. Following along to the west, Stag Island appeared, and from there to a point a mile below the Oakland House both banks of the St. Clair River were visible. St. Clair City was clearly outlined upon the sky, and smoke could be seen ascending from the tops of several smokestacks. The mirage was visible for more than an hour.

[FROM THE NEW YORK HERALD.]

Helen Keller.

The slender young girl in her dainty little white evening dress, who, despite the fact that she is blind and deaf and was unable, until within a few years, to utter articulate sounds, stood in the parlors of the Wright-Humason School, at No. 42 West Seventy-sixth Street, New York, recently and received her guests with as animated conversation as if her short life had been one continuous stretch of social impressions enough to crowd five senses, has excited interest all over the world.

Although only fourteen years old, Helen Keller has a wider range of information than has sifted into the minds of the vast majority of men through their unimpaired senses, sometimes when their hair has silvered.

She was not born blind, and deaf, and mute, but lost the use of these faculties through scarlet fever at the age of eighteen months. She later regained the ability to speak through the instruction tending to make her formulate words, even though unable to hear the sound.

Miss Sullivan, who went to her when she was seven years old, has been her constant companion and teacher ever since.

The marvelous dexterity which Helen is acquiring in the reading of speech and conversation by simply placing her fingers on the lips of the speaker is equaled by the readiness with which she repeats accurately the words which are spoken to her.

As various persons of social and literary prominence paid their respects to her she talked with them upon topics of mutual interest. When Edmund Clarence Stedman approached and began a conversation, she surprised him by repeating one of his poems, and was equally well prepared to prove to Richard Watson Gilder her familiarity with his dainty songs.

From a large volume of Tennyson in the raised letter of print of the blind she read several stanzas of "In Memoriam." When asked if she preferred that to others of that author's poems, she replied: "Oh, no! I like it, but not the best, because it is so full of sorrow. I am very fond of 'Dora' and 'The Princess,' but it is very hard to say which I like best. I think the one I love most is a very short one—one of only six lines," and turning upward a face filled with exquisite purity, she repeated:

> Flower in the crannied wall,
> I pluck you out of the crannies;
> Hold you there, root and all, in my hand,
> Little flower; but if I could understand
> What you are, root and all, and all in all,
> I should know what God and man is.

The slight touch of her finger tips as her friends passed before her supplied her wonderful memory with the material for recognition, and as they bade her good night she took each by the hand, and with a slight touch of her hand to the face, with courteous phrases and kindly wishes, bade each by name good night.

One of the most impressible features in her attitude to her more fortunate fellows—more fortunate so far as receptive faculties are concerned—is her extremely lovable disposition, which accords so well with the look of perfect happiness upon her face and her laughing air of freedom from care.

The Susquehanna River to be Harnessed.

An ambitious plan for utilizing the waters of the Susquehanna River as a means of generating electric power is about to be carried out. A certificate of incorporation has recently been granted to the Susquehanna River Electric Company and work is to be commenced as soon as the spring freshets are over. The surveys have already been completed. It is proposed to dam the Susquehanna River near Conowingo, Maryland, and erect a large electric power house, similar to the one now in operation at Niagara Falls. The power obtained in this way will be supplied to Philadelphia, Wilmington and Baltimore, and other intermediate points. It is expected that it will be used extensively in operating street railways and electric lights. The land at the proposed site of the dam has been purchased and the plans have been made for an immense plant. The capital stock of the company has been placed for the present at $100,000, but it is understood that the Westinghouse Electric Company are behind the project and that the capital will be increased, when the work is to be commenced, to several millions of dollars. It is expected that the company will be prepared to supply power to the several cities by January 1, 1896.

Natural Gas at 1,000 lb. to the Square Inch.

At Martinsville, Va., on December 20, while Captain James Clegg, foreman of a pipe line gang for the New Martinsville Natural Gas Company, was calking a pipe under a thousand pounds direct pressure, the pipe burst, throwing Captain Clegg nearly 100 feet into the air and killing him instantly, his neck being broken. Half a dozen other workmen about him were knocked down and severely injured.

The Steam Yacht Giralda.

Mr. McCalmont's twin screw steam yacht Giralda, built in England, is reported as being a most remarkable vessel. She combines all the features of a first class pleasure yacht with the speed of the fastest ocean-going steamers within the compass of 1,508 tons yacht measurement; and she has a coal-carrying capacity enabling her to make a voyage of over 3,500 nautical miles at a speed of 15 knots, or of nearly 6,000 nautical miles at a speed of 12 knots. Upon the measured mile upon the Clyde she realized a speed of 20·9 knots, and she approached the same speed in a lengthened run in the Solent. It has been hitherto held that the capacity of an ocean-going steamer was necessary to provide engine power for a speed of over 20 knots, if in addition to the boilers and coal bunkers there should be provided the ordinary complement of staterooms. Her trials have also provided some interesting data on the question of vibration. At 17 knots the vibration is excessive, but below and above that speed the vibration disappears. Two Gardner guns and four Hotchkiss guns, with two electric search lights of Admiralty pattern, assist the conception of an amateur cruiser; and the crew of sixty naval reserve men, procured from the Orient service, encourage the idea that, although a private yacht, the Giralda may be regarded as at any time available as an Admiralty dispatch boat. The vessel has been designed and constructed by the Fairfield Company, at Govan. Mr. McCalmont holds a master's certificate and navigates the boat himself.

African Volcanoes.

In 1891, when Emin Pasha started west from Victoria Nyanza on the journey that ended in his violent death, he and his comrade, Dr. Stuhlmann, were the first white men to see the big mountain Mfumbiro, 120 miles from the lake which Capt. Speke, many years before, had placed on his map on native information. They found that Mfumbiro was not an isolated cone, but the most eastern of a hitherto unknown range of volcanic origin. Their first purpose was to determine the outlines of Lake Albert Edward, and they did not stop to explore these mountains; but Dr. Stuhlmann sent home an interesting report of the natives that Virunga, the most western summit of the chain, was a fire mountain, from whose top smoke was often seen to issue, and from which noises were heard like the bellowing of cattle.

On December 8 a cablegram reached Europe from Count von Gotzen, the German explorer, announcing his arrival on the lower Congo, after crossing Africa from east to west. About the same time a letter he had written in central Africa in June last arrived. It contained brief but interesting details of his visit to Mount Virunga. There have been reports of plutonic activity among the Rif Mountains, in northwestern Morocco, but the hostile natives have prevented investigation. The subterranean forces that formed the great trough and piled up mountains of lava and ashes east of the great lakes show, by solfataras, hot springs, and other phenomena, that they are not yet entirely spent. But until the discovery of Mount Virunga no active volcano was known to exist in Africa.

While still far away Count von Gotzen saw a thin column of smoke ascending from the principal crater, and later he found that the rim of this orifice is 11,400 feet above the sea. The volcano, therefore, is not a snow mountain, and is not so tall as its nearest neighbor on the east, which, according to Stuhlmann, is about 13,000 feet high. It took Von Gotzen several days to force a passage through the dense forest and to scale the steep mountain side. At last he stood upon the edge of the crater and looked down upon a most interesting spectacle.

The crater is about a mile in diameter, and the top of the encircling wall, on which the explorer stood, is about 160 feet above the crater floor. The inner side of the wall was too steep for comfortable descent, and in view of what was going on at the bottom, there was absolutely no temptation to make the journey.

The yellow-hued bottom of the crater floor was as smooth as the surface of a lake, and the explorer believes he was looking down upon an expanse of molten lava. Above this smooth surface rose the walls of two orifices, as regularly formed as though they had been made of masonry. From the more northern of the two orifices, which was over 300 feet in diameter, a small volume of smoke was issuing, accompanied by a noise that sounded like the roll of distant thunder. There were unmistakable indications that outside of this crater another center of eruption exists on the west side of the mountain, but the explorer was unable to push through the woods to reach it.

For some years a little lake has appeared on the maps some distance south of the place this volcano has been found to occupy. It is Lake Kivu, seen by no white man until Von Gotzen stood on its shores soon after he had looked down into the smoking crater. He says the lake stretched away before him like a sea, and, though it was a clear day, he could not see its southern shores. He believes the lake is almost as large as Lake Albert Edward. Its outlet is supposed to be the Rusisi River, which enters the north end of Lake Tanganyika.

It is too early to regard the large prizes of African discovery as all won when such interesting and important results reward research as those attained by the latest traveler across Africa.—N. Y. Sun.

Swallowing Alive.

The recent strange incident at the Zoological Gardens, London, when a boa nine feet in length swallowed a companion of eight feet, has recalled many wonderful stories of similar kind. A few years ago a python of huge size seized a boa, and would have swallowed it entire but for the energetic exertions of Mr. Bartlett and of the keeper of the serpent house. Several cases have been since narrated, sometimes by eye witnesses.

Mr. Wells, the marine superintendent of the Brighton Aquarium, in a letter, says that "fishes are as often notable for extraordinary swallowing as snakes and reptiles. Some years ago there were three large pike in one of the tanks here, from 18 to 28 lb. The pike of 28lb. swallowed his companion of 18 lb., but the victim proved too long for him, so the tail projected out of his mouth. After several days, as digestion went on, the whole of the tail disappeared. Last summer a conger eel swallowed a large dog-fish and kept it down, though it was swallowed tail first, which is very unusual with fishes."

Many will remember the curious adventure at the Brighton Aquarium, when a dog-fish swallowed a large octopus. The octopus was in the adjoining tank, and during the night climbed over the glass wall in search of prey. A dog-fish seized and swallowed the formidable intruder. The specimen was for many years exhibited, but has now disappeared, possibly from the cost and trouble involved in preserving the contents of the immense jar.—Public Opinion.

Japanese Troops.

Rear-Admiral Belknap, of our navy, now in retirement, says:

"There is not one incident of personal prowess or of individual valor in the annals of England that may not be matched by a similar deed of courage and heroism in the annals of Japan. The great sea fight of Dem-No-Ura was as significant and more hotly contested than the battle of Trafalgar. No British force has ever met on the field of battle an Oriental race at all the equal of the Japanese in martial character and intrepid spirit. Her army to-day is the equal of the British army in organization and equipment, superior to it in homogeneity, mobility, and discipline. She has seen, this long while, the British squeeze upon the throat of China and the brutal means used to accomplish it, and she does not mean that such fate shall overtake her, if stout hearts and strong arms can prevent it. No British minister will hereafter attempt to enact the meddling and menacing part of a Parkes at Tokio, nor will any British fleet bombard with impunity a second Tengoshima. The sun does not shine on a more determined or intrepid race than that of Japan. The martial spirit of Japan antedates that of Britain, and hereafter, whether on land or sea, the arch robber of the universe will find all she cares to meet if she comes into hostile contact with the forces of Dai Nippon."

Typhoid from Oysters.

Dr. Charles A. Lindsley, of New Haven, secretary of the Connecticut State Board of Health, says that, beyond the shadow of a doubt, the epidemic of typhoid fever at Wesleyan University, at Middletown, Conn., could be traced to oysters infected with the germs of disease.

It has been ascertained, he said, that the oysters provided for a series of banquets at the university had been placed in a portion of the Quinepiac River to fatten. The fattening ground is close to the house of the dealer from whom the oysters for Middletown consumption were obtained, and it was learned that two members of the dealer's family had suffered from the fever, and that excreta had been discharged into a sewer which empties into the river close to the place where the oysters had been placed.

African Saltpeter.

Deposits of saltpeter that promise to be the most valuable in existence have been discovered in Cape Colony. They are claimed to be true potassium nitrate, which is one of the chief ingredients of gunpowder, and is worth about $80 a ton. The principal supply at present is from Chile, but the "Chile saltpeter," as it is called, has to undergo a costly chemical process before use. Nitrate of potash is found in but small quantities as a rule, as it is soluble in water, and is, therefore, washed out of the soil by the rain. The dryness of the South African climate is supposed to account for the richness of the latest find, which, it is stated, will reduce the price of the mineral one-half.

THE UNITED STATES BATTLE SHIP INDIANA.

We illustrate the battle ship Indiana at sea, showing one of the three most powerful additions yet made to our navy, the war ships of the Oregon type. The Indiana, Oregon and Massachusetts are sister ships, the type taking name from the Western State. The three ships were authorized by act of Congress dated June 30, 1891.

The keel of the Indiana was laid at William Cramp & Sons' yard in Philadelphia in 1891, and the vessel was launched February 25, 1893. The general dimensions are as follows: Length on load water line, 348 feet; width, 69 feet 3 inches; draught, 24 feet; displacement, 10,200 tons. The engines of 9,000 indicated horse power, of vertical triple expansion type, drive twin screws. The coal room capacity is 400 tons, to which must be added a bunker capacity of 1,800 tons. The contract speed is fifteen knots, which was exceeded on the preliminary trial trip last March.

The armament consists of four 13-inch, eight 8 inch and four 6-inch breech-loading rifles, with a secondary battery of twenty 6-pounder and six 1-pounder rapid-firing guns and four Gatling guns.

The ship is very heavily armored. Her side plates are 18 inches thick. The main battery is fought from large and small turrets, surmounting low barbettes. The large turrets are 15 inches thick, and their barbettes are 17 inches thick. The smaller turrets are 6 inches thick, with 8 inch and 6 inch barbettes. The deck, of 2½ inch steel, is flat. The ship is to carry a crew of 400 men. The contract price was $3,020,000.

The bow protruding below the water line constitutes a ram which adds to the ship's powers. On the preliminary trial trip alluded to, a speed of 14·02 and 14·12 knots was attained on natural draught at 122 revolutions, and 15·6 on forced draught at 128 revolutions. These trials were made before the ship was down to her loadwater line. When in perfect trim, higher results are anticipated. The pitch of the screws used on the trial was 15 feet 8 inches; it is thought that screws of higher pitch may eventually be selected. The vessel turned through 180 degrees in five minutes.

The turrets are mounted by the new system within circular barbettes, the latter about three feet high. They are always ready for action, there being no joint to be loosened before they can turn, as in the older type deck turrets. The two main turrets are situated on the main deck, one forward and one aft of the superstructure, each containing two 13-inch guns. The 8-inch guns occupy four smaller turrets on top of the central superstructure, one near each corner. Six torpedo tubes and a fighting mast are provided. The ship is considered about as powerful as any vessel afloat.

The ship is furnished with a complete outfit of Blake pumps, including independent air pumps for the main condensers, main and auxiliary feed pumps, main and auxiliary fire pumps, bilge pumps and others.

New Sugar Process.

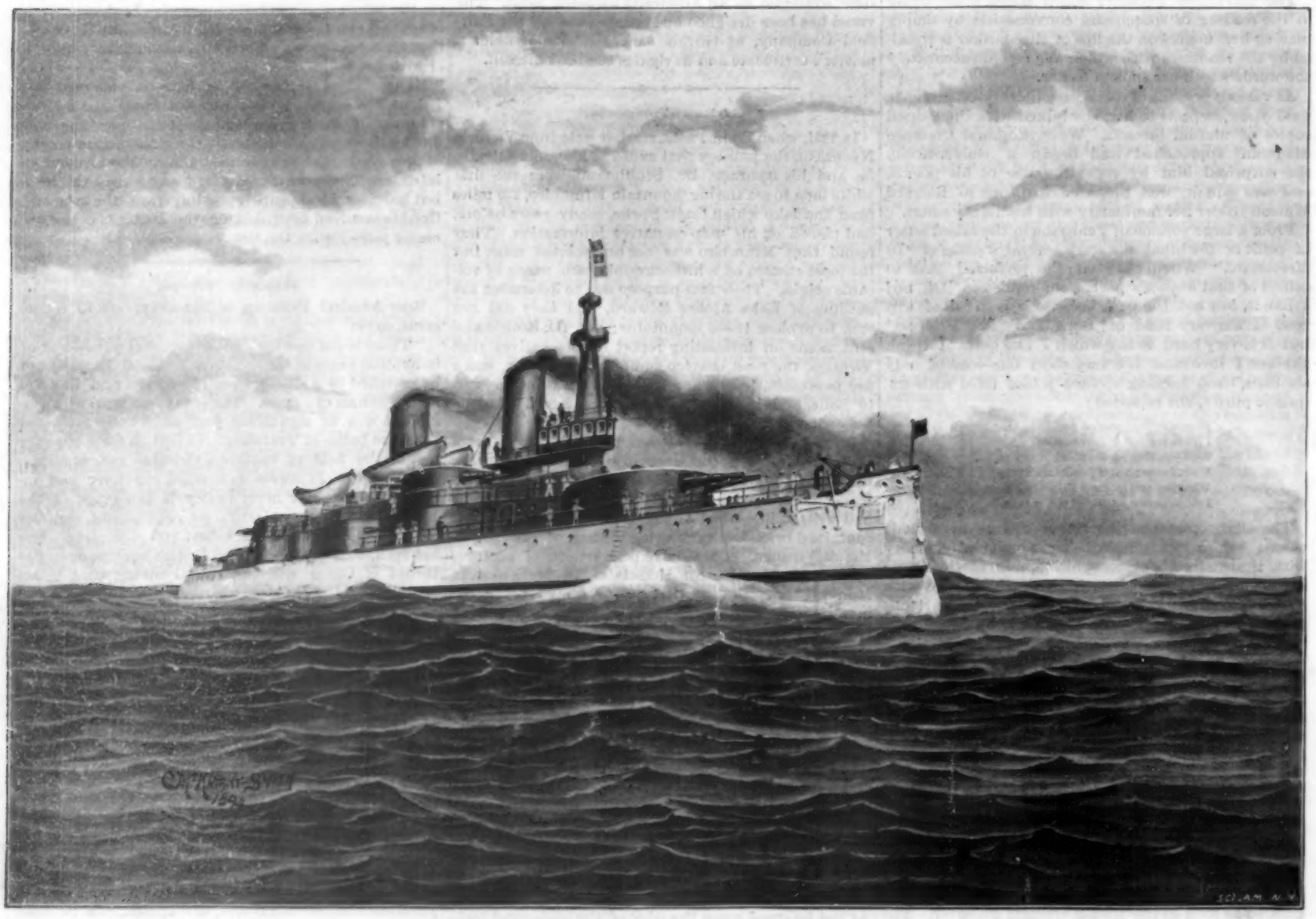
The Barbados Herald says: Rolling mills have hitherto been the means universally employed for the separation of the saccharine from the cane, but under the most favorable conditions, and after double and even treble millings, from 10 to 13 per cent of the saccharine is still retained in the fiber, or, as it is called, megass.

The new machine is designed and patented by Mr. D. Drummond. The results of the most recent test cannot be got for some days, but in several preliminary trials the issue was of the most satisfactory description. With cane that had been cut for over two months the machine succeeded in extracting within less than 8 per cent of the total juice, and the megass, when analyzed by Dr. Clark, city of Glasgow analyst, was found to contain only 7 per cent of sugar.

Briefly, the process is as follows: The cane is cut into lengths of four or five inches, and passes, without being touched by hand, into a cylinder where it is crushed. When all the juice possible has been expressed by a powerful pressure, the megass is dollied and subjected to a steam bath in order to extract any juice left in the cells of the cane. The pure juice and the diluted juice are carried into separate tanks by suction pumps and the megass by a mechanical arrangement is discharged by the crushing cylinder, to be used as fuel. The whole of the operations of feeding, crushing, discharging and pumping are performed by one man. It is intended to make five different sizes of machines, capable of dealing with 5, 10, 15, 20 and 25 tons of cane per hour, and the largest does not occupy more than 8 feet of floor space. The advantages claimed for the machine, which is equally suitable for treating beet root, are: Complete extraction of the sugar at one operation; minimum risk of breakdown, as there is no gearing or revolving shafts, and that a number of machines can be worked at considerable distance from each other, from one hydraulic and steam installation.

American Armor Plates.

When, in June, 1887, after a careful inquiry by an official commission, our government found it necessary to place an order with European manufacturers for several thousand tons of armor plates for our new navy, the announcement was received by the public with expressions of ill-concealed disappointment and mortification. It was some compensation for this feeling when it was stated, almost simultaneously, that the government had also placed a large home order for armor plates with the Bethlehem works, under such conditions as would enable the company to secure the appliances and set up an adequate armor producing plant. It required over three years to bring this plant to effective working condition in turning out armor plates for battle ships, but the Bethlehem works have since, owing to improved processes, and by the use of a nickel steel alloy and the Harveyizing of the outer surface of each plate, turned out armor plates which already have the reputation of being the best made in the world. A practical testimonial of their excellence was afforded by a cable telegram received by the Bethlehem Company on the 15th ult., ordering, on behalf of the Russian government, the whole amount of armor needed for two new Russian battle ships, the Sebastopol and Petropavlovsk. The contract called for 2,080 tons of armor plate, which is said to be the largest single order ever put out in Europe, and means a full year's employment for all hands in the armor department of the Bethlehem works. The value of the order is estimated at between three and four millions of dollars, and the gratification of the successful bidders and of the public is heightened by the fact that the order was obtained over the keen rivalry of fourteen competitors, among whom were the leading armor plate manufacturers of England, France, Germany and Italy.



THE UNITED STATES BATTLE SHIP INDIANA.

A Prize for a New Gas Burner.

The list of prizes offered for competition by the Committee of the Societe Technique du Gaz en France, which appears in the current number of the Journal des Usines à Gaz, contains an item of special interest at the present time. It is a prize of $2,000, to be awarded in whole or in part to the inventor of a new incandescent gas burner presenting some marked superiority over the burners now in existence. The burner is to be sent in before the 1st of April, 1895; but the committee will determine whether or not they will extend the time till the 1st of May, 1896.

IMPROVED GATLING GUN.

Important and valuable improvements have recently been made in the Gatling gun, and also in its feed mechanism, by the Gatling Gun Company, of Hartford, Conn. The gun retains its primary features of revolving barrels and locks. The new feed makes it possible, however, to manipulate the gun with greater facility than heretofore. The rate of firing is greatly increased and the gun may be fired at any angle of elevation or depression, the feed being positive in its operation. In the old form of Gatling gun the feeding depended upon gravity, and this made it impossible to fire the gun at any considerable elevation or depression. The old feeding apparatus was bulky and was a conspicuous mark for the enemy. The new feed is much lighter, smaller, and more economical than the old.

The cartridges used in the new feed are attached to strips of tin, and are fed to the gun with great rapidity. They are discharged and the empty shells thrown aside automatically while the barrels of the gun are revolving.

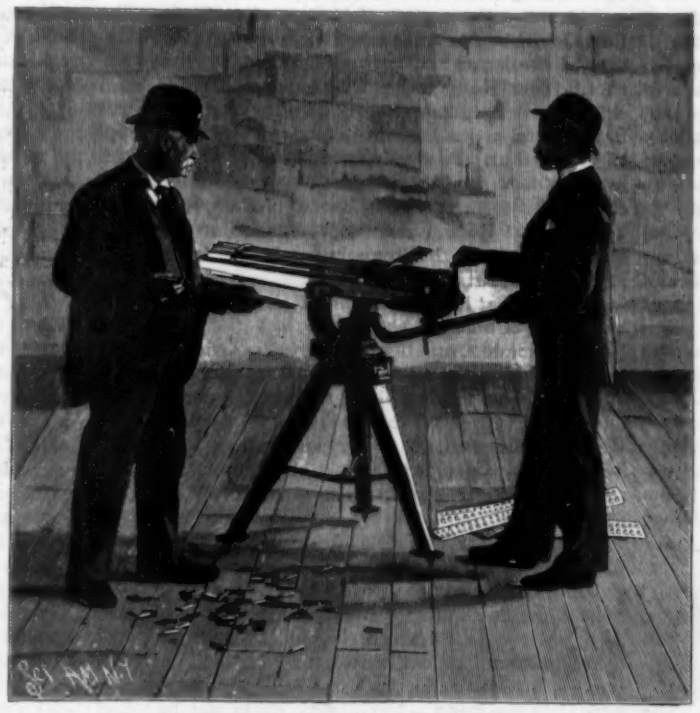
For fort and naval uses, the gun may be operated by an electric motor, the firing being controlled by a button, the gun being fired rapidly or slowly, as desired. The motor is attached to the breech of the gun, and appears, when in motion, merely as an elongation of the breech. It develops one horse power and weighs about 100 pounds. The entire mechanism is very compact, and is inclosed to protect it from injury. This new motor attachment makes it possible to discharge the gun at the rate of over 3,000 shots per minute.

The manufacturers of the improved gun attach particular importance to the gain by the new feed in cheapness, compactness, and the general simplicity. Each feed strip holds 20 cartridges and costs but a few cents, and may be refilled, if necessary, as many as thirty times.

The space occupied by the former bulky feed mechanism may now be used for ammunition. Ten thousand rounds of ammunition may now be carried in the limber for immediate use.

The improved gun and new feed are so simple and easy of manipulation that any soldier can fire the gun; and this will be found a great advantage in ordinary service, either on land or on shipboard.

Further information may be had by addressing the Gatling Gun Company, Hartford, Conn.



THE IMPROVED GATLING GUN—ARMY MODEL.

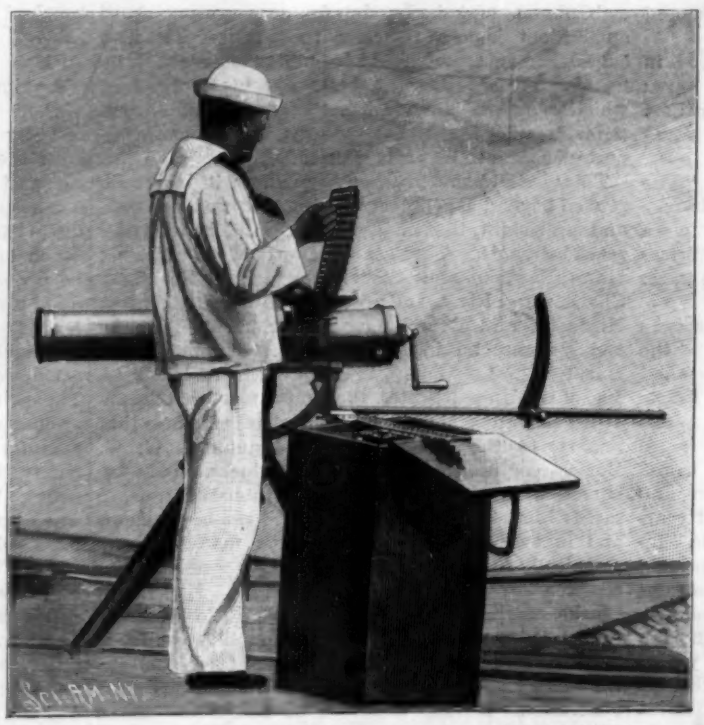
Preservation of Propeller Shafts.

It is now about two years ago since the first of the propeller shafts fitted with the arrangement devised by Mr. Mudd, of Hartlepool, for preventing their destruction by galvanic action and corrosion, were sent to sea, and they are now rapidly coming in for examination. The device has proved successful, the shafts on examination having no trace whatever of galvanic action or corrosion, nor of the defects and decay that formerly so extensively resulted. The s.s. Guernsey, whose shaft has been running at sea for eighteen months, had her tail shaft drawn at a dry dock in the Tyne recently, and the preserver pulled loose from its attachment to the shaft, when it was found that the shaft had been entirely preserved, the rubber sleeve itself had taken no harm, and was capable of being cemented down again for a further period at sea. The s.s. Zanzibar, whose shaft was drawn at a dry dock in Cardiff, was found in perfect order, the sleeve having adhered splendidly to the shaft and retained its elasticity, forming a really good preservative, no corrosion whatever having taken place. The s.s. Elmville, dry-docked at West Hartlepool, had her tail shaft drawn and examined after having been twenty months at sea, when the same result was found. The sleeve was in perfectly flexible and good condition, and when turned back from its attachment to the shaft, the shaft and the ends of the brass liners were found in the same perfect condition in which they left the lathe when new, having taken no harm whatever during the twenty months' work. The best qualities of rubber retain their natural elasticity indefinitely when kept immersed in water and free from light and air, and these conditions are fairly satisfactorily fulfilled in the inside of a stern tube, so that the very conditions that were previously destructive to the tail shafts themselves are now those that are relied upon in this apparatus to keep the covering material in good condition, and these examinations, after long use at sea, prove that reliance may safely be placed upon them for this purpose.

SEEDS 2,000 years old have been known to sprout.

The World's Debt to Astronomy.

Astronomy is more intimately connected than any other science with the history of mankind. While chemistry, physics, and we might say all sciences which pertain to things on the earth, are comparatively modern, we find that contemplative men engaged in the study of the celestial motions even before the commencement of authentic history. The earliest navigators of whom we know must have been aware that the earth was round. This fact was certainly understood by the ancient Greeks and Egyptians as well as it is at the present day. True, they did not know that the earth revolved on its axis, but thought that the heavens, and all that in them is, performed a daily revolution around our globe, which was, therefore, the center of the universe. It was the cynosure, or constellation of the Little Bear, by which the sailors used to guide their ships before the discovery of the mariner's compass. Thus we see both a practical and contemplative side to astronomy through all history. The world owes two debts to that science: one for its practical uses and the other for the ideas it has afforded us of the immensity of creation.



THE IMPROVED GATLING GUN—NAVY MODEL.

The practical uses of astronomy are of two kinds: One relates to geography; the other to times, seasons, and chronology. Every navigator who sails long out of sight of land must be something of an astronomer. His compass tells him where are east, west, north, and south, but it gives him no information as to where on the wide ocean he may be, or whither the currents may be carrying him. Even with the swiftest modern steamers it is not safe to trust to the compass in crossing the Atlantic. Not only the navigator, but the surveyor in the Western wilds must depend on astronomical observations to learn his exact position on the earth's surface, or the latitude and longitude of the camp which he occupies. He is able to do this because the earth is round, and the direction of the plumb line not exactly the same at any two places. It is true that a considerable distance on the earth's surface will seem very small in its effect on the position of a star. Suppose there were two stars in the heavens, the one in the zenith of the place where you now stand and the other in the zenith of a place a mile away. To the best eye unaided by a telescope those two stars would look like a single one. But let the two places be five miles apart, and the eye could see that there were two of them. A good telescope could distinguish between two stars corresponding to places not more than a hundred feet apart. The most exact measurements can determine distances ranging from thirty to sixty feet. If a skillful astronomical observer should mount a telescope on your premises, and determine his latitude by observations on two or three evenings, and then you should try to trick him by taking up the instrument and putting it at another point one hundred feet north or south, he would find out that something was wrong by a single night's work.

We cannot measure across oceans from island to island. Up to the present time we have not even measured across the continent, from New York to San Francisco, in the most precise way. Without astronomy we should know nothing of the distance between New York and Liverpool, except by the time which it took steamers to run it—a measure which would be very uncertain indeed. But by the aid of astronomical observations and the Atlantic cables the distance is found within a few hundred yards. Without astronomy we could scarcely make an accurate map of the United States, except at enormous labor and expense, and even then we could not be sure of its correctness. But the practical astronomer being able to determine his latitude and longitude within fifty yards, the positions of the principal points in all great cities of the country are known, and can be laid down on maps. The world has always had to depend on astronomy for all its knowledge concerning times and seasons. The changes of the moon gave us the first month, and the year completes its round as the earth travels in its orbit. The results of astronomical observation are for us condensed into almanacs, which are now in such universal use that we never think of their astronomical origin. At some of the principal observatories of the country astronomical observations are made on every clear night for the express purpose of regulating an astronomical clock with the greatest exactness. Every day at noon a signal is sent to various parts of the country by telegraph, so that all operators and railway men who hear that signal can set their clock at noon within two or three seconds. People who live near railway stations can thus get their time from it, and so exact time is diffused into every household of the land which is at all near a railway station, without the trouble of watching the sun. Thus increased exactness is given to the time on all our railroads, increased safety is obtained, and great loss of time saved to every one.—Prof. Simon Newcomb, in the Chautauquan.

Fireproof Buildings.

The attention of architects and builders has been directed for some time to the difficult task of constructing an absolutely fireproof building. It has been found that a rise in temperature to 300 degrees F. will throw the heaviest steel columns more or less out of place, and that a rise to 500 F. would ruin the best steel construction. Fireproof buildings are usually constructed, therefore, by surrounding the girders with material to protect them from the heat. An elaborate form of such a construction has been introduced recently in the new Tremont Temple in Boston. It consists in placing about the great steel girders terra cotta blocks on all the exposed sides and strapping them together with iron. Upon this is stretched expanded metal lathing covered with a heavy coat of Windsor cement. Over this, in turn, comes iron furring, and this is provided also with a layer of expanded metal lath. The finishing plaster is laid on top of this last layer. It will be seen that this arrangement provides first a dead air space, next a layer of terra cotta, a Windsor cement covering, then a second air space, and finally a second thick layer of Windsor cement.

THEY cut glass now by electricity.

Concretes, Cements and Mortars.*

The "White City" of antiquity was Rome, and most of the so-called marble houses of the Augustinian period were not such in reality, but owed their stone-like appearance to the plasterer's art, which at that time had reached a high state of perfection, and gave to stone the appearance and induration of the finest marble.

It is on record that some of this plastering, which in some particulars resembled the white "staff" used on the World's Fair buildings, lasted for centuries, but the art which enabled man to make and apply this material was lost before the examples perished.

It is evident the ancients, at all events the Egyptians, Greeks and Romans, possessed a knowledge of eminent mortars and cements, as is proved by the phenomenal strength and durability of the remains of edifices still standing to receive their tribute of admiration. Doubtless much was due to the durability of the stone used, but builders of to-day know that more was due to the superiority of the mortar employed. True, the action of time has fostered improvement and aided petrifaction, but had the mortar been composed of inferior materials, or manipulated unskillfully, it would have been rotten centuries ago, and the stones it held together would have been lost to us forever.

In all highly civilized communities good mortar was and is a necessity. Indeed, the quality of mortar used in any community may almost be accepted as an index of its civilization.

The city of Nineveh has left us comparatively nothing of its history, as it was a city of mud and unburnt clay, adobe walls and loamy mortar. Of Babylon we know more, as it was a burnt brick built city, with walls bonded together with bituminous mortars. Egypt, that cradle of the arts, built the massive pyramid of Sackkara of bricks cemented with Nile silt! Later, she raised her temples and pyramids of hard syenite, and held them together with imperishable asphaltic mortars; but the greater works of this wonderful people were held together with a mortar formed by an admixture of hydrate of lime and Nile silt. The Greeks, in their earlier public buildings, dispensed with mortar to some extent, and used dowels or pins made of cypress wood to hold the stones in place. All their joints, however, were rubbed or ground together, so that the junction of the stones was almost perfect; later on, mortar was used in many of their structures. The Romans, the most practical builders of antiquity, surpassed all peoples, ancient or modern, in their knowledge of the materials they made use of in their building operations, and it is to their intelligent attention to mortar making that we moderns are enabled to see the work of their hands. The importance of the manufacture of mortar was such that in all large works, national, municipal or private, it was deemed necessary to employ supervising officers, called ediles, whose duties were to inspect materials and superintend the manipulation of all mortars and cements used in the building.

We may glean some idea of the labor expended in the making of mortar from Vitruvius, who says: "That men mixed the ingredients by beating them with staves until the whole mass was smooth and plastic."

In another place the same author says: "The builders mixed puzzolana with lime to give it (the mortar) greater strength, and piers built in the sea would be as strong as if built on land, as the mortars made this way would harden just as well in the water as on the land."

It is quite evident also that the Phœnicians were aware of the qualities of puzzolana, for some of the docks and wharves of Carthage were built of stone and cemented together with a mixture of lime and puzzolana. It is difficult at this date to trace to its source the invention of lime mortar, but it is due either to Egyptian or Phœnician ingenuity, and was a grand stride in the direction of civilization and culture, and it is curious to think that for several thousand years no further progress in its manufacture was made. Indeed, until about the commencement of the present century, common lime mortars were made in the same manner that was adopted four thousand years ago.

In the matter of producing a water-resisting mortar, much more skill and knowledge were required; yet we find that the possession of this knowledge by the ancients antedates the Christian era by several centuries, as the use of puzzolana mixed with lime to form a cement was known to both Phœnicians and Romans long before Vitruvius flourished.

The discovery of the manufacture of a mortar that would set and harden under water was another step forward in human culture, and evinced a knowledge of chemical conditions by the early builders that is really amazing. Hydraulic lime and the modern product of cement were unknown to them, but they seemed equal to the occasion, for they found that a proper admixture of lime, puzzolana and pounded bricks formed a cement that answered well their purposes.

It is not known at what period the fact was discovered that certain limestones would yield a lime or cement capable of hardening under water. The French writer, Vicat, in the beginning of the present century, was the first to make an extended investigation of the laws governing the action of limes. Up to the middle of the eighteenth century puzzolana imported from Italy and France, and from Germany via Holland, was the standard ingredient for hydraulic mortars in England.

In 1756 John Smeaton, C.E., was intrusted to build a new lighthouse on the site of the Eddystone, which had recently been destroyed by fire, and he set to work to discover some material at home which would resist the action of both surf and sea. The lime from Aberthaw answered his purpose. He investigated the cause, and proved before long that only those limes resist water which, when treated with acids, leave argillaceous residues. The spell was broken, and artificial cements followed each other rapidly after that. Parker took out his patent for Parker's cement in 1796. This consisted of lumps of chalky clay gathered from the sea coast. It became known as "Roman cement," because of its being similar in color to the Roman puzzolana. In its action it was somewhat like to our Rosendale. By inference, it followed that hydraulic cements could be produced artificially of lime and clay.

Parker made a number of experiments with clinkers, pulverized limestones, and the calcareous detritus produced by the wear of limestone roads near Leeds, mixed clay with it and burned it in a kiln at a red heat. He called the resultant "Portland cement," because it was similar in color to Portland stone. The name thus given has clung to this cement ever since, no matter where made.

In 1827 Sir Charles Paisley improved and cheapened the process of manufacture, by selecting English chalk as being best suited to the purpose, owing to its uncrystalline, fine grained quality. He mixed it with clay from the deposits at the mouth of the Medway, near Chatham, and calcined them. This made a good cement, but as the merits of white heat calcination were then not known, the quality could not be relied upon.

The credit is due to a German, Dr. Fuch, of Munich, of first formulating a scientific theory concerning the manufacture of cement, and stripping it of its mystery. He proved in a prize essay that Portland cement could be made anywhere and from a variety of materials, abundant in every locality. This essay, being translated in several tongues, was the means of raising a host of manufacturers, with the result of bringing disgrace on the manufactured article, as it lacked uniformity of quality, and could not be relied upon, and architects and engineers avoided its use and stuck to old methods.

In 1858 John Grant, a London engineer, made a number of experiments, and so far succeeded in improving the quality that he completed the Thames embankment and the London drainage works without an accident, so far as the cement was concerned. The experiments made by Grant led him to believe that the heaviest cement was the best, and his reputation, which was high, had the effect of spreading abroad the impression that to have weight was of more importance than to be finely ground.

This idea did much harm, even after it had been proved beyond a peradventure that it was fineness, and not weight, that gave to the cement its superior tensile strength. Through the efforts of Reid, Brund, Mann, Newman, and others in England; M Noel, MM. Chatony and Rivot, and others in France; Dyckerhoff, Michaelis, and Bauschinger in Germany; of Zuirek and Hanenschild in Austria; Gen. Gilmore, W. W. Maclay, Elliot C. Clarke, E. J. Desmith, and F. Kidder, of the United States, the truth has been established that the materials being good, it is fineness that imparts to the material its good quality. W. W. Maclay, engineer of the New York docks, made between seven thousand and eight thousand tests, to satisfy himself as to what constituted the best cement, and in every case he found—where materials were chemically equal—that the finer grades were the best adapted for work requiring strength. Mr. E. C. Clarke, of the Boston Main Drainage Works, made some twenty-five thousand tests with a like result.

Mr. Kidder, who watched a number of tests made at the School of Technology, Boston, arrived at the same conclusion. It may therefore be laid down as an axiom, that, no matter how good the material may be, if it is not ground to a fine texture, it cannot be relied upon. Brands possessing a uniformity of texture will give better results than an admixture of brands, and when once a brand has been found to do all that was claimed for it, and it fills the bill, it is best to stick to that particular brand. A good cement, when properly set, should equal in strength good building stone, and should have a like or greater specific gravity.

At this writing there are quite a number of brands of Portland cement in the market, many of them being imported from England, Germany, France and Belgium. Some brands are exceedingly good, while a number of them are inferior to many made in this country. Indeed, some of the Portlands made in Pennsylvania, New Jersey, and other States are as good and reliable as some of the imported high grades, though I am free to confess that but few of our own brands grade as uniformly as the Dyckerhoff or Boulogne makes. Doubtless the quality of uniformity of the two brands named is due to the care and perfection of manufacture, for neither France nor Germany possess raw material in as good a quality as is found in many places in this country.

The English Portland is a mixture of clay, consisting chiefly of silica and alumina and chalk, or nearly pure carbonate of lime. The clay and chalk are ground roughly, and mixed in the proportion of one to three by weight, then again ground under water. The mixture is then allowed to settle and the water to drain off, and the mass is then dried and made into cubes, bricks, or balls, two or three inches in diameter, which are placed in a kiln and heated to a white heat. They are then allowed to cool, and afterward reduced to an impalpable powder. Unlike natural cements, Portland does not deteriorate when exposed to dry air. Dr. Michaelis, a noted expert on cements, says that the "raw materials, when dried at 212° F., consist essentially of seventy-five to seventy-nine per centum, by weight, of carbonate of lime and twenty-four to twenty per centum of silicate of alumina, clay. These when burned represent sixty-two and one-half to sixty-seven per cent of lime and thirty-three and one-half to twenty-nine per cent of silicates, silica, alumina, oxide of iron, leaving four per cent for carbonate of magnesia and accessories. After the hardening of the hydrated cement, a transformation, by compressive reaction, has taken place into hydrates, silicate of lime as the most important ingredient, in hydrated aluminate of lime, ferruginous lime, hydrate of lime, basic sulphate of lime, and carbonate of lime."

The results of analyses by other investigators by microscope and chemical tests verify the conclusions arrived at by Dr. Michaelis. A preponderance of alumina favors quick setting, while an increase of iron has an opposite effect. The partial vitrification obtained in the burning causes the particles forming the whole to lose their globular character and become laminated or flattened. This feature reduces the bulk and increases the value of the cement, inasmuch as the laminated texture achieves more intimate contact by surface.

The English standard requires these tests, viz., that the cement shall weigh one hundred and ten pounds to the strict imperial bushel; that it shall pass through a sieve having from one thousand six hundred to three thousand meshes per square inch; and that its tensile strength shall be two hundred pounds per square inch at the end of seven days, the first passed in damp air, and the rest under water. American engineers exact a somewhat higher standard, some specifications calling for a tensile strength of two hundred and fifty pounds to the square inch.

* Fred T. Hodgson, C.E., in the Brickbuilder.

Army Ordnance Factories.

A valuable official summary of the present facilities of the various United States ordnance factories has recently been presented to Congress in connection with the annual request for appropriations. During the past year the work accomplished at these plants has been highly satisfactory. At Watervliet, the great factory for sea coast guns, the output has been eleven 8 inch, eleven 10 inch and six 12 inch guns, and work is in progress on a 10 inch wire-wound Crozier and upon seven 12 inch mortars. The factory is equipped for the manufacture of guns up to and including those of 12 inch caliber, and contracts have been made for the tools necessary for manufacturing 16 inch guns. The principal need at Watervliet is for a proving ground suitable for testing the large guns of their manufacture. At present such guns must be taken to Sandy Hook for this purpose, thus incurring great expense. The cost of this improvement will be $98,840. The next ordnance factory mentioned is that at Watertown, celebrated for the manufacture of great gun carriages. This plant constructs 12 inch gun lifts, barbette carriages for 10 inch guns, 8 inch carriages and carriages for the muzzle-loading 15 inch smoothbore and 8 inch converted rifles. Cast iron projectiles and other castings are made, and there is much valuable machinery for making navy chains, shackles, swivels and the life-saving shot lines. At the ordnance station at Frankford the ammunition for the new small arms is manufactured in large quantities. Last year the output was 2,537,000 cartridges, balls and blank for the 45 caliber rifles and carbines and 2,750,000 for the 38 caliber. The output also included shrapnel for field guns, fuses, gun sights and various similar articles.

The report also mentions the important work in gun manufacture carried on at Rock Island and Springfield, the powder supplied by the plant at Benicia and the satisfactory tests conducted at Sandy Hook. The report gives evidence of a very efficient system of ordnance factories, and it is to be hoped that Congress will provide ample appropriations for carrying on their work in the future.

BROOKLYN'S MEMORIAL ARCH.

Prospect Park, which contains 516 acres, is one of the chief ornaments of the city of Brooklyn. The management of the park has always been conservative and the result has been most satisfactory. The winding paths and bridle roads have little in them which suggests the formal arrangement of an artificial park, but rather the grounds of some large English estate. Prospect Park contains few statues, but on its huge open spaces or commons children play at will without fear of injuring the grass. In some parts of the park sheep are kept, which adds much to the rural aspect of the park. Although the park itself has not been ruined by artificial constructions, it has been given a worthy entrance. The plaza at the west entrance to Prospect Park is ornamented by an imposing fountain and an excellent statue of Abraham Lincoln. At the left of the fountain rises Reservoir Hill, a commanding site from which a glorious view is obtained of the sister cities, New York Bay, the Narrows, and the Atlantic Ocean. On this hill was erected the new high service water tower, which forms a conspicuous landmark.

The entrance to the park is now rendered most impressive by the triumphal arch which bears, just below the cornice, the words "To the Defenders of the Union, 1861–1865." There is no more fitting monument to celebrate past victories than a triumphal arch, and it is to be hoped that the present generation has seen the passing of the tasteless granite column, surmounted by an indifferent effigy of a Union soldier. The corner stone of the Brooklyn arch was laid in 1889, and our illustration shows the present condition of it. It has already cost about $250,000, and will probably cost as much more before it is completed. The architect is Mr. J. H. Duncan, of New York City, and the bronze groups are to be furnished by Mr. Frederick MacMonnies, of Paris and New York, the sculptor who executed the great Columbian Fountain at the recent Chicago Exposition and the statue of Nathan Hale in City Hall Park, New York.

The arch is built of light granite and is 80 feet long, 71 feet high and 45 feet wide. On each side of the abutments are massive pedestals which are to be surmounted by the colossal bronze groups. On the inner and outer faces of the abutments bronze bass reliefs emblematic of victory are attached. Above the cornice are to be wreaths in which the names of the various battles in which Brooklyn men participated will be inscribed. The top is reached by stairs which will communicate with a room over the arch, where war relics will, in time, be exhibited.

MEMORIAL ARCH AT THE ENTRANCE OF PROSPECT PARK, BROOKLYN.

The Submarine Detector.

It is now a little over a year since the Russian monitor Rusalka foundered with all hands in a storm in the Gulf of Finland. Steps have since been taken by the Russian government to discover the precise locality of the ill-fated vessel, with the view of raising her, an expedition having been organized for that purpose. This expedition consisted of a flotilla of several vessels equipped with divers and all necessary apparatus, including one of Captain McEvoy's submarine detectors, which was made in London for the expedition. It has recently been ascertained that the spot where the Rusalka sank is a reef in the locality of the Waster Tokan. The reef is submerged, and it is supposed that the Rusalka grounded there, and subsequently slipped off into the surrounding deep water. Her precise position has been localized in 30 fathoms of water by the submarine detector, a description of which, says the Times, may prove interesting. This apparatus is based on the principle of Prof. Hughes' induction balance, and it consists simply of an electrical arrangement contained in a small mahogany box, which is carried on board the searching vessel, and a sinker which is trailed along the bottom. When the sinker approaches a mass of steel, iron, or any other metal the adjustment is deranged, and sounds become audible in the telephone, while they are reduced in intensity as the sinker recedes from the metallic object. The search was continued for several weeks, and the exact position of the foundered vessel was at length placed beyond all question, as every time the searching steamer passed over a given spot the electric indicator of the detector sounded loudly, thus affording evidence that a large mass of metal was submerged below. After the vessel was located the divers descended and examined her.

Temperature of the Ocean.

The temperature of the bottom of the Atlantic Ocean, as determined by the resistance of the Atlantic cables, is said to be 38° F., which is a mean for the whole year. That at the bottom of the Mediterranean, measured in the same way, is said to be 57° F.

A Close Call.

The exact time at which darkness gives place to dawn—the dividing time between day and night—was legally determined, and a verdict of $35,000 given on the decision, in the Court of Common Pleas in Philadelphia recently. A young woman was knocked down by a locomotive on the Reading road while she was walking over a crossing at Norristown at 6:30 o'clock in the morning of February 14, 1893. The engine did not display a light, nor did it signal with whistle or bell. The company claimed that it was not negligent, because at that hour dawn was breaking and no light was needed, and the entire case rested on whether or not it was daylight when the accident occurred.

The sun rose on the day of the accident at 6:54 o'clock. Several astronomers and other experts testified that half an hour before sunrise it is as dark as at any time of night. From that time until sunrise light comes so slowly that the point of half light is reached only seven minutes before sunrise. During the last seven minutes before sun-up light comes very rapidly, until the full day breaks. The plaintiff's lawyer claimed, therefore, that at the time of the accident, twenty-four minutes before sunrise, it was pitch dark. The jury rendered a verdict of $25,000 in her favor.

A Complete Pompeiian House.

A valuable discovery has been made at Pianella-Setteimini, near Pompeii, on the property of a certain Mr. Vincent de Prosco. A house has been unearthed which was covered at the time the city was buried, and it is said to be in a more perfect condition than any building yet discovered. It contains several large apartments and three bathrooms, with the basins in sculptured marble, and with leaden pipes ornamented with bronze faucets. The three rooms correspond, says a writer, in describing the discovery, to the "calidarium, tepidarium, and frigidarium, which were always to be found in ancient houses of the first class. In consequence of the eruption of Vesuvius in A. D. 79, the Pompeiian houses brought to light heretofore have been roofless, almost without exception. Fortunately, however, that on the property of M. De Prosco is perfect, and archæologists are happy over the fact. The roof measures almost forty-four feet in length."

RECENTLY PATENTED INVENTIONS.

Engineering.

STEAM ENGINE VALVE GEAR.—Lemon O. Burk, Corning, Ark. To permit of conveniently reversing the engine and delivering the steam directly into the ends of the cylinder, this inventor has designed a simple and durable valve gear designed to be very effective in operation. The reversing link is rocked from the main shaft, and a block sliding in the link is connected by a rod with the valve stem, a raising and lowering device for the rod moving the block in the link. The device consists of an adjustable rock shaft having an arm with an eye through which the connecting rod slides. The steam chest has openings at its ends and removable cover sections, there being valve casings in the ends of the casing, and the middle portion of the chest forming the chamber for the live steam.

DOUBLE ACTING PUMP. — Frank J. Brown, Alfred Allen, and Solomon Allen, Halstead, Kan. In the lower end of a tubular well casing, according to this invention, is held a double cylinder, with differential bores, the upper and smaller discharging into a casing above, while the lower and larger cylinder has an inlet opening controlled by a suction valve. In this cylinder is also a plunger connected by a hollow stem with a plunger in the upper cylinder, there being on the upper end of the stem a valve passing the water into the upper cylinder. A rod connected with the hollow stem is coupled to a lifting rod whereby plungers in the two cylinders are reciprocated. The construction is simple and durable and the pump is designed to be very effective.

Railway Appliances.

SWITCH WORKING MECHANISM. — James and Charles McGhee, Sandy Valley, Pa. This invention provides an inexpensive mechanism for application to an ordinary switch, by which it may be worked from a passing train, with means for automatically locking the switch to hold the main line open and prevent the switch from being tampered with. Vertical shafts with striking arms are geared to a crank shaft adapted to throw the switch, an arm on the crank shaft receiving a forked post, and a pin moving through the arms being actuated by the crank, while the shaft is turned and the pin moved by levers fulcrumed at the side of the track, the levers being actuated by the approaching train.

RAIL.—Lawrence K. Devlin, Helena, Montana. To form a duct or passageway in rails for electric wires, according to this invention, the rails are formed with a longitudinal recess, extending centrally up from the bottom, the web of the rail being made somewhat larger than usual, and thus forming a double web. The bottom of this recess is closed by a plate preferably of wood, snugly fitted, and at the rail joints is employed a hood, corresponding in shape to the recess, the hood extending a short distance into the meeting ends of adjacent rails.

RAILWAY CROSSING GATE. — James Huth rford, Brooklyn, N. Y. This is a sliding gate, with sliding trips at each side to be operated by a moving train, there being pinions actuated by the trips and shifting bars connected with opposite sides of the gate, the bars having rack surfaces engaging opposite sides of the pinions, so that the action of one is the reverse of that of the other. The arrangement is such that the gates are automatically closed by an approaching train before the latter reaches a crossing, and automatically opened after the train has passed.

STREET CAR FENDER. — William H. Brock, Brooklyn, N. Y. This is an improvement on a formerly patented invention of the same inventor, providing an auxiliary shifting device whereby, when the fender is drawn beneath the car, and strikes an object, the fender will automatically move outward to a position to receive the object, in case the motorman or gripman should fail to bring it into requisition. The shifting device is of simple construction and very light, occupying but little room, not interfering with other attachments beneath the car body.

BALL BEARING WHEEL.—Hallam F. Coates, Cambridge, Ohio. According to this invention the hub portion of the wheel has a central socket into which a filler of slightly less diameter is slid, the filler having annular grooves in which are bearing balls engaging the wall of the chamber, means being provided for adjustably connecting the filler on the axle. In this wheel the use of bolts, gaskets, caps, nuts, and other loose parts is dispensed with, the axle is protected, and the friction reduced to a minimum. The construction is simple, there being but few parts and these easily put together.

Mechanical.

BENCH STOP. — Josiah Daily, North Peoria, Ill. This stop may likewise be used as a square and marker, having a side arm and at right angles thereto a cross or head bar, the latter being graduated and at a higher level. The side arm forms a guide or abutment for the board applied to the stop, and has near its end a removable stud adapted to enter one of a series of sockets along both edges of the bench near its top, to bring the stop to any desired point.

PIPE OR HOSE COUPLING.—Simon A. Stahley, Suspension Bridge, N. Y. This invention comprises a coupling member having a head formed with guideways tapering from top to bottom, a rack held alongside one of the guideways, and a second head engaging the guideways, while a gear wheel turning loosely on the second head is adapted to mesh with the rack. The improvement enables the operator to positively produce a non-leaking joint, and permits of readily connecting or disconnecting the coupling members on their full pressure and without the use of separate tools.

BELT SHIFTER AND BRAKE FOR COTTON PRESSES.—Thomas M. Wallace, Marion, Ala. This improvement is applicable for presses with a reciprocating follower, especially with "self-tramper" presses, where the follower is actuated by toggle levers and a rotating screw shaft. In combination with two sets of fast and loose pulleys are slidable belt shifters whereby the follower may be returned very quickly, to economize time in compressing the several charges of cotton. In the same connection and coacting with the belt shifter is a friction brake mechanism, that the speed of the follower may be maintained up to the limit of its movement in either direction without strain or injury to the press.

WALL PAPER PRINTING MACHINE.—William H. Waldron, New Brunswick, N. J. This inventor has been awarded two patents for improvements by which wall paper is produced by two impressions from two machines, with an intermediate drying apparatus, the design for the paper of the second machine registering accurately with the design already printed by the first machine, irrespective of the shrinkage or expansion of the paper caused by the drying apparatus. A compensating device is provided for the printing rollers of the second machine, whereby they will be run at a speed corresponding to the design of the paper passing over the cylinder, one of the inventions covering an electrically controlled compensating device and the other a mechanical one. The latter is actuated by an operator watching the paper while the electrical device is automatically operated by the paper, according to its shrinkage or expansion.

ROCK DRILL.—Harvey P. and George B. Jones, Denver, Col. According to this invention a track is held by a fastening device to a bed adjustably secured to a supporting standard, a drill frame sliding on the track, while there is a ratchet connection between the drill frame and the track, and drill mechanism carried by the frame. The drill may be held in almost any place where it is desirable to work. The blow is given by a spring-propelled hammer operated by a crank handle, the drill being turned after each blow by a simple mechanism, while the recoil is made to feed it forward in position for rapid drilling.

Agricultural.

CORN PLANTER AND FERTILIZER DISTRIBUTER.—Jacob W. and William C. Duryea, Blawenburg, N. J. This invention provides independent devices for simultaneously dropping seed and distributing fertilizer therewith, each of the devices being provided with a cut-off mechanism under control of the operator for regulating the delivery of seed or fertilizer. An endless chain marking device is also provided, the machine traveling upon the chain and thus marking the ground between the rows, the markers on the chain making impressions simultaneously with the discharge of the seed.

STRAW CONVEYER.—William L. Johnson and William L. Hay, Franklin, Tenn. This is an improvement in pneumatic conveyers for thrashing machines, making the discharge end of the main blast tube at the mouth of the conveyer section, there being a detachable cap for each end, while a supplemental blast chamber has its discharge mouth opening into the conveyer section. The improvement may be readily applied to any of the modern thrashers, being secured to the discharge end and readily thrown up and back on the machine, to give the operator full access to all the working parts of the thrasher for cleaning and adjusting the sieves.

FIELD THRASHING MACHINE. — Axel Anderson, Ronda, Texas As this machine is drawn forward in a field it is designed to harvest the tops of the standing grain, leaving the stalks in the ground, the machine thrashing the grain from the heads, separating the chaff from the grain and delivering the grain into a suitable receptacle. The grain heads are forced into the thrashing cylinder by means of a feed mechanism as the machine is drawn along, and this cylinder may be readily raised or lowered and held in adjusted position, according to the height of the grain.

DITCHING MACHINE. — Alfred C. Carter, Greenfield, Iowa. Operating somewhat after the manner of a plow when drawn across a field, this machine is designed to dig a ditch of uniform width and depth and deposit the loosened earth at one side of the ditch. Pivoted on a pin on the plow point are parallel knives which extend upward and are connected by cross ribs, these knives being just far enough apart to cut the walls of the ditch and make it the desired width. The plow cuts the ditch horizontally and raises the loosened earth to a mouldboard carried by the beam, from which the earth is thrown to one side of the ditch.

Miscellaneous.

MARINE VELOCIPEDE.—William Dry den, Brooklyn, N. Y. This invention comprises a hull of the catamaran order whose sections are united at the bow, there being a nearly central seat from which an operator actuating a pedal shaft may rotate a propeller, there being also a centerboard between the hull sections and a regulating rod by means of which the operator may readily raise and lower it. A steering device is also within convenient reach, and the construction is capable of use as a life raft when required.

STREET SWEEPER. — William H. Walker and Thomas H. Boyce, New York City. This machine is designed to be connected with a cart by which it is drawn along, when a brush rotated from the large wheels of the scraper delivers the dirt onto a pan within an elevator casing, the sweeping being then removed by scrapers to buckets which discharge into a chute, down which the sweepings pass into the cart. When the cart is filled it is detached from the sweeper and an empty one connected in its place, a continual sweeping up and taking away of the dirt being thus provided for.

HOSE BRIDGE AND TOWER. — James Blake and Emil F. Begiebing, Union Hill, N. J. For the use of fire departments these inventors have devised an apparatus which may be collapsed and folded into small compass, or extended and raised, the bridge for carrying lines of hose over a track being extensible for a considerable length. It may also be used to discharge water from the bridge without the use of a hose, and thus serve as a fire tower, with revolvible nozzle operated from the truck. It has a convenient and simple arrangement of braces, and the whole affair may be readily turned and easily operated.

WINDMILL.—Seth K. Humphrey, Omaha, Neb. According to this invention a horizontal shaft carries horizontally supported sails, and means are provided whereby, through a chain belt, a group of sails are operated to cause the various sails to shift their positions. Should the wind shift, the carriage acts automatically upon the stationary portion of the mill to bring the sails up into the wind. The support for the sails for attachment to the main driving shaft is very simple and inexpensive and thoroughly braced.

HYDROCARBON BURNER. — Charles E. Cookerly, Kansas City, Mo. This burner is adapted for an ordinary cook stove, or in a heating stove or other heater, there being within the shell a steam supply pipe and suspended fire pan, over which is an oil retort with depending discharge pipe, the oil well consisting of an open-ended tube embracing the discharge pipe and delivering into the fire pan. A steam generator affords the steam combined with vaporized oil to form the hydrocarbon gas, the parts being so arranged that there are no small openings to get clogged with soot, and the steam and oil vapors being combined and burned in an economical manner to produce intense heat.

DOOR CHECK.—Charles W. Hamshaw, Gallatin, Mo. An arresting and holding device to automatically engage and retain a house door in open position has been devised by this inventor, comprising a hook and casing holder through which projects a pivoted latch, there being an adjustable base block in the casing, a spring supported on the block engaging the under side of the latch. Attached to the door is a base piece from which a hook limb projects outwardly and downwardly, and when the door is held open it may be released by a slight exertion of force.

PIANO CASE.—Alfred J. Newby, New York City. This invention relates to the mechanism for automatically moving up the front of the case by the lifting and pushing in of the keyboard fall. The case has a swinging front, with fall and movable slide plate hinged to it, and a lever hinged on the case has its lower end connected with the slide plate and its upper end extending opposite the swinging front, there being also a vertically movable guide bar parallel with the slide plate, and cranks secured to the guide bar and pivoted to the slide plate.

DAMPER FOR SWISS MUSIC BOXES.—William H. Haschke, Brooklyn, N. Y. For boxes having a pin cylinder acting on the teeth of a fixed comb, this invention provides an improved independent damper attachment for the teeth of the comb, so arranged that the damper only acts on the tooth immediately previous to the sounding of the tooth by the corresponding pin of the pin cylinder.

AUTOMATIC MUSICAL INSTRUMENT.—The same inventor has obtained a patent for a musical instrument in which a traveling perforated sheet actuates the star wheel or other picking mechanism engaging and sounding the comb. The star cylinder has rotatable disks, each with picking pins and gravity plungers, a traveling sheet having slots for the plungers, while a revolving cylinder has blades to engage the ends of the plungers extending below the traveling sheet. The improvement is designed to prevent tearing or otherwise injuring the sheet, whereby the sheets may be used over again without danger of changing the tunes.

CONFECTIONERY MACHINE. — Simeon J. Hicks, Englewood, Ill. A machine more especially designed for cutting buttercups and similar forms from a drawn and flattened piece of candy has been devised by this inventor. The invention consists principally of a hinged stripper plate to support the pieces cut by the knives, the plate being adapted to pass over the lower knives, while a pivoted frame carries the upper knives, and catches held in the frame engage the stripper plate to swing it upward to move the candy from between the lower knives, dropping it at the rear of the machine.

MACHINE TO CUT STICK CANDY.—John M. Allardyce, Galveston, Texas. A reciprocating cutter is, according to this invention, mounted in a traveling bed, and mechanism controlled by the bed-operating mechanism raises the cutter and allows it to drop, whereby the long sticks of stick candy laid on the table may be cut into the lengths desired. The machine is of very simple construction and easily operated.

BOX.—Zada B. Webb, Whippany, N. J. Fancy boxes for holding bonbons, etc., are the subject of this improvement, the invention providing for making a simple and cheap box of attractive appearance. It is of flexible material, self-closing, and the fastening may be readily converted into a handle. The blank of which the box is formed has side pieces with registering apertures through which are passed ribbons or cords which are drawn up in bringing the box to shape.

WRITING TABLET.—Max Rubin, New York City. According to this invention a pad or table may be quickly and conveniently reversed while in hinged connection with the body of the tablet proper, the supports for the tablet being so constructed as to be concealed when the tablet is in open or closed position. The hinged connection between the tablet and the pad is very simple and inexpensive, and readily applicable to the framework of the tablet.

HAT PIN.—Osborn Congelton and Gertrude R. Boyd, Philadelphia, Pa. This is a simple and inexpensive device to be fastened permanently to the hat, and is readily operated and provided with prongs which cannot injure the head or hat, but are sure to engage the hair and hold the hat in place. An eyeletted crown tip is fastened to the hat, and the pin has a guide frame with spring-pressed slides, prongs projecting through the eyelets on the crown tip, while there are outwardly projecting arms with knobs on the sides, by which the device is operated.

MATCH RECEPTACLE.—Fred D. Halsey, Tyler, Texas. The body of this match box is that of an animal with open mouth, the match repository being on its back, from which a trough communicates with a mouth passage, a spring-pressed rod forming the tongue and serving also as a finger piece, there being ignition devices in the passage and the tail forming a stop. But a single match can be withdrawn at a time, and the match is ignited before it is entirely removed, thus preventing the abstraction of a number of matches where only one is meant to be offered free.

DENTAL NAPKIN HOLDER.—George A. Bronson, St. Louis, Mo. This improvement comprises a dished presser piece, a curved handle piece and a keeper tang, for holding in proper position in the mouth of a patient a folded napkin or porous pliable pad to absorb saliva moisture that might otherwise obstruct the work of the dentist. The same inventor has obtained a further patent for an additional improvement in this line, by means of which the tongue is held depressed and the napkin pressed against the tongue on each side of the teeth being operated upon, thus effectually absorbing the moisture during an operation.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

LA METALLURGIE EN FRANCE. Par Urbain le Verrier. Avec 66 figures intercalées dans le texte. Paris: Librairie J. B. Bailliere et Fils. 1894. Pp. xi, 333. Price 75 cents.

POOR'S DIRECTORY OF RAILWAY OFFICIALS. 1894. Ninth annual number. Containing lists of the officers of all railways in North America and of the leading organizations auxiliary to the railway system; lists of officers of South American and Hawaiian railways, etc. Compiled from official information. New York: Poor's Railroad Manual. London: Effingham Wilson. Pp. 400. Price $4.

TRANSITION CURVES. A FIELD BOOK FOR ENGINEERS. Containing rules and tables for laying out transition curves. By Walter G. Fox. New York: D. Van Nostrand Company. 1893. Pp. 80. Price 50 cents.

SCIENTIFIC AMERICAN BUILDING EDITION.

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1. Plate in colors, showing a residence at Bronxwood Park, N. Y. Two perspective elevations and floor plans. Cost complete $3,500. A picturesque design. Mr. Chas. N. Hoar, architect, New York City.
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3. A cottage at Mt. Vernon, N. Y., erected at a cost of $4,500. Perspective elevations and floor plans. Mr. Walter F. Stickles, architect, Mt. Vernon, N. Y. An attractive design.
4. The handsome residence of W. K. Clarkson, Esq., Brooklyn, N. Y., erected at a cost of $15,000. Two perspective elevations and floor plans. Messrs. J. C. Cady & Co., architects, New York City.
5. A residence of moderate cost at Bronxwood Park, N. Y. Perspective elevation and floor plans. Mr. A. F. Leicht, architect, New York City. A pleasing design.
6. The residence of W. D. Love, Esq., at Bronxwood Park, N. Y. Two perspective elevations and floor plans. Mr. W. H. Cable, architect, New York City. A neat design treated in the Queen Anne style.
7. A Colonial residence at Flatbush, L. I., erected at a cost of $7,500. Two perspective elevations and floor plans. Mr. John J. Petit, architect, Brooklyn, N. Y.
8. A residence at Mt. Vernon, N. Y. Two perspective elevations and floor plans. A pleasing design in the Colonial style. Mr. Chas. E. Miller, architect, New York City.
9. A picturesque and well appointed residence at Belle Haven, Conn., recently erected for E. C. Converse, Esq. Four perspective elevations and floor plans. An excellent design. Mr. Bruce Price, architect, New York City.
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Notes & Queries

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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Minerals sent for examination should be distinctly marked or labeled.

(6335) W. A. P. writes: We had erected in our office a natural gas stove, giving it a 3¼ inch vent pipe; ever since there has been a continual dripping of fluid while the stove is lit. We trust you will be able to advise us with a remedy and explain the same. A. The gas in burning produces water. We would suggest the use of a tee at the lowest point of the vent pipe, with a small drip pipe leading thence outdoors. This should be bent into a trap near the stove and the vent pipe from the stove should pitch downward toward it. The presence of water indicates a cold chimney, which shows that the room is getting the heat, which is as it should be.

(6336) J. A. McC. asks: 1. Is there a single cylinder gas engine made to-day that receives an impulse at each stroke of the piston, or two to the revolution? A. Double acting gas engines have been made, principally in England and in France, and some are still in use. There are some difficulties in the operation of this class of engines that have placed the single acting engines in the lead. 2. What is the best proportion per volume of gasoline gas and air for the best results in gas engines? A. The best and most economical mixture is 1 part gasoline vapor to 10 parts of air. 3. If a jet of air and one of gas be admitted into a cylinder at the same instant from opposite sides, in such a manner as to strike each other with considerable force, will they mix sufficiently well to explode in contact with an electric spark, and will such an explosion take place with a considerable degree of certainty if the mixture come in contact with iron at a good red heat? Also at what heat may iron be under such circumstances and the gas be free from danger of explosion while under compression? A. The practice is to admit gas and air at any convenient point. They will ignite by electric spark or by a heated tube into which the mixed gases are compressed. The tube to be at a full red heat. Will not explode at a black heat. 4. To what extent is a charge of gas and air compressed at the moment of explosion in the most economical engines? A. There are engines with and without compression of the mixed gas and air. Compression may be from 5 to 10 pounds. 5. What can you say in regard to the relative efficiency of the tube and electric spark as an exploder? Also with reference to safety and economy? A. The electrical ignition system claims high efficiency in the uniformity of explosive effect. 6. Is there a work on the gas engine that would be of real, practical value to a tyro, and if so, what is it? A. There are two excellent works on gas engines. Robinson's "Gas and Petroleum Engines," $5.50, and Donkin's "Gas, Oil and Air Engines," $6.50 by mail. 7. Do you think it possible to drive a catamaran whose hulls are 15 inches wide, having sharp lines, round knuckles and flat bottom, 28 feet long, drawing 7 inches of water, at a speed of 12 miles an hour on dead water with a paddle wheel placed between the hulls? If so, at what position in the length of the hulls should it be placed, and what should be the length and width of bucket and what diameter and speed should the wheel have? A. The speed of 12 miles per hour may be obtained; but with the difficulty of overloading the boat with the weight of engines and wheel, 9 to 10 miles may be attained. Wheel should be two-thirds the length of hull from bow. Wheel 6 feet diameter, 4 feet wide.

(6337) C. A. C. asks: 1. What is the safe carrying capacity of No. 30 silk-covered copper wire, such as is used in telegraph relays (in amperes)? A. 0·15 to 0·20 ampere if wound in a tight coil. 2. What should be the carrying capacity of fusing wire to protect the same (in amperes)? A. About the same as given above, for they are very safe figures. 3. Also, how can telephones be used on a telegraph line about 1,500 feet long, with three stations on same? We use ordinarily the telegraph line, but wish to use both telegraph and telephones together. The batteries are located as follows: Three at one end and five in the middle. How can it be arranged so that either end may call the middle station (using the telegraph instruments for a call), and the middle station be arranged so that he may switch his telephone on to either section of the line, leaving the other end out or grounded? A. Use back contact keys at middle station, with ground connections there. 4. Also will telephones work through the five batteries without any trouble? A. The batteries will not prevent the telephones from working.

(6338) G. A. D. asks: Does the sun move? Is this earth perfectly round, or is it flattened at the poles? If so, how is it proved? A. The sun moves in space toward the constellation Hercules at the rate of about 16 miles per second. In this sense it moves. It also moves by revolution upon its own axis. The apparent daily motion of the sun through the heavens is not a real movement, but is an optical effect upon our perception, due to the revolution of the earth upon its own axis. The earth's form is a spheroid of revolution, as is proved by measures upon the meridian with their terminals compared with observations for their latitude. Also by the force of gravity, as deduced from the varying lengths of a pendulum at different latitudes for a given time beat.

(6339) C. H. H.—No one has the right to make a patented article for his own use without the consent of the patentee.

(6340) H. A. W. & Co. say: In Notes and Queries of SCIENTIFIC AMERICAN of December 1, J. J. H. asks, "How high above level of its source will an ordinary hydraulic ram raise water?" You answer from 100 to 200 feet. About two years ago we put in a Rife's ram (advertised in your paper). With this ram we raise water to our farm 243 feet high, pipe line 4,300 feet long; our feed pipe to ram is 300 feet long, 5 inch pipe and 11 feet fall, and gives us 60 gallons per hour and sometimes runs up to 90 gallons.

(6341) R. L. H. asks: 1. In what number or numbers of the SCIENTIFIC AMERICAN SUPPLEMENT can I find directions for making instruments for the measurement of the following: Volts, amperes, ohms, and watts? A. See our SUPPLEMENT, Nos. 353, 398, 423, 440, 552, 556, 563, 603, 604, 618, 734, 811. 2. How many cubic feet of gas can be obtained from 1 gallon of water by the electro analysis process, and how long would it take to decompose it with 20 amperes, if I use 1 square foot for each electrode? A. About 157 feet hydrogen and 78 feet oxygen, requiring about 1,000 hours. The size of electrode is a superfluous statement. 3. Are gold and platinum the only metals from which I can catch the gases separately? If not, please mention other cheaper ones. A. You can use iron or copper in a solution of caustic soda. 4. What is the fractional horse power of the motors described in SUPPLEMENT, Nos. 761 and 641, and how many volts and amperes does each require? A. No. 761 is about one-thirtieth horse power, No. 641 is about one-tenth horse power. 5. How many volts and amperes does the dynamo in SUPPLEMENT, No. 161, give? About 12 volts and 1½ amperes. 6. How can I calculate the candle power of a lamp? A. Allow 3·1 watts per candle power. 7. With 10 volts and 5 amperes, can I make an induction coil that will give 50 volts and 100 amperes? If so, how? A. No. It would involve creation of energy.

(6342) P. C. T. asks: 1. What make of storage battery can you recommend for charging by gravity cells? A. For storage batteries address some of the dealers who advertise in our columns. 2. What occurs if circuit is closed without cutting out gravity batteries? A. The storage batteries keep on receiving their charge; the circuit is necessarily closed when charging. 3. What causes buckling of plates? A. Too rapid a discharge. 4. What capacity should they be for cauterizing purposes—how many volts and amperes are most practicable? A. This depends entirely on the length and size of the cauterizing wire or instrument. 5. What is the difference between a galvanic and faradic current? Johnson's Cyclopedia states magneto and secondary currents from induction coils are faradic, and yet we read of galvanic medical batteries. A. Johnson's Cyclopedia is correct. In medicine it may be desirable to use a galvanic current.

(6343) L. A. F. asks: 1. How can the danger resulting from the falling of a private telephone wire onto a trolley wire be avoided? A. By guard wires placed over the trolley wires, or by good insulation on the telephone wire. 2. In case of its falling onto the trolley wire, is there any danger to building upon which it is strung? A. There is a certain amount of danger, but the high resistance of the telephone apparatus is to some extent a safeguard. 3. Is there any easy way to remove the crystals that form in a bichromate of potash battery? A. Immerse completely in a tub of water and then place the cell on its side with its bottom raised, as by resting on a brick, or completely invert it. It must be kept full of water.

(6344) W. S. asks: When sailing from New York to Montevideo does the compass point toward the south magnetic pole after crossing the equator? A. The compass is not reversed in crossing the equator. Its south pole points to the southern magnetic pole, with variations due to the lines of magnetic declination. The only change that requires adjustment is the dip of the needle, as in north latitudes the north end of the needle must be counterbalanced for the dip, which must be changed or reversed in southern latitudes.

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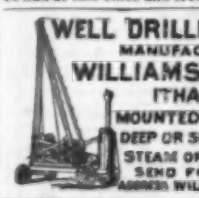

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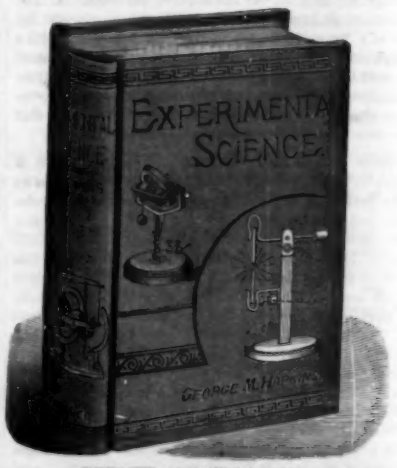

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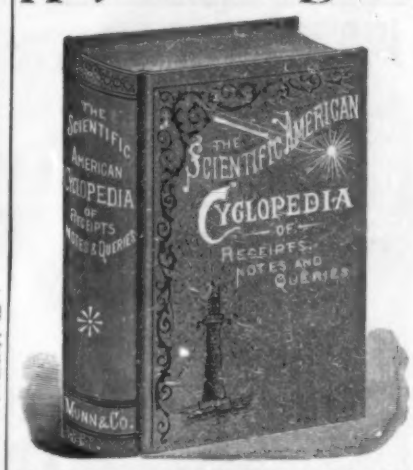

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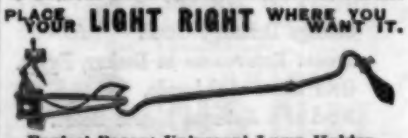

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